California Regional Water Quality Control Board
Central Coast Region

Total Maximum Daily Loads for Fecal Coliform in Pajaro River, San Benito River, Llagas Creek and Tequisquita Slough

Preliminary Project Report

July 2007

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To request copies of the Basin Plan Amendment and Total Maximum Daily Loads for Fecal coliform for Pajaro River, San Benito River, Llagas Creek, and Tequisquita Slough, please contact Larry Harlan at (805) 594-6195, or by email at lharlan@waterboards.ca.gov. Documents also are available at: http://www.waterboards.ca.gov/centralcoast/

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Adopted by the
California Regional Water Quality Control Board
Central Coast Region
on _______________, 200x

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on _______________,200x
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on _________________. 200x

Cover Photograph: Pajaro River at Betabel Road, by Larry Harlan (January 2007)

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1 INTRODUCTION

This Preliminary Project Report addresses fecal coliform impairment of Pajaro River and three tributaries within the Pajaro River watershed; San Benito River, Llagas Creek, and Tequisquita Slough. Water Board staff prepare Preliminary Project Reports to describe the project and to begin developing recommendations. Preliminary Project Reports are typically used to inform stakeholders of the project status and to also scope potential environmental impacts of the project. Staff will prepare subsequent project reports based on stakeholder input or other information. The Final Project Report for this Total Maximum Daily Load (TMDL) project is scheduled to be completed February 2008 and staff plans to make recommendations to the Water Board in July 2008.

Section 303(d) of the Clean Water Act requires the State to establish TMDLs for fecal coliform at a level necessary to attain water quality standards. The TMDLs must incorporate seasonal variations and a margin of safety that takes into account any lack of knowledge concerning the relationship between load limits and water quality.

Some fecal coliform genera are pathogenic to humans. Fecal coliform and a subset of fecal coliform, *Escherichia coli* (*E. coli),* are used as indicators for the presence of other pathogenic organisms. Fecal coliform and *E. coli* will be referred to as indicator bacteria for the purposes of this report.

Note that the units of *density* and *concentration* are used synonymously in this report when referring to numbers of indicator bacteria in a stated volume of water. In addition, the terms log mean, geomean, and geometric mean are also used synonymously when referring to the mathematical operation performed to quantify indicator bacteria.

2 WATERSHED DESCRIPTION

The Pajaro River watershed encompasses approximately 1,263 square miles (807,940 acres). It is about 60 miles southeast of San Francisco and Oakland and 120 miles southwest of Sacramento. The watershed is almost 90 miles in length and varies from 7 to 20 miles in width (Figure 2-1). The Pajaro River watershed drains into the Monterey Bay and is the largest coastal stream between San Francisco Bay and the Salinas River.

The watershed lies within Monterey, San Benito, Santa Cruz, and Santa Clara counties. The city of Watsonville is located in the watershed near the confluence of the Pajaro River with Monterey Bay. Major Pajaro River tributaries are the San Benito River, Tres Pinos Creek, Santa Ana Creek, Pacheco Creek, Llagas

Creek, Uvas Creek, and Corralitos Creek. The watershed is predominantly mountainous and hilly, and level lands are confined to the floodplains of the Pajaro River and its major tributaries. Elevations in the watershed range from sea level where the Pajaro River enters the Monterey Bay to over 4,900 feet in the headwaters of the San Benito River. Average annual precipitation ranges from 13 inches in Hollister to more than 44 inches in the Santa Cruz Mountains. Much of the annual precipitation occurs during the six month period from November through April.

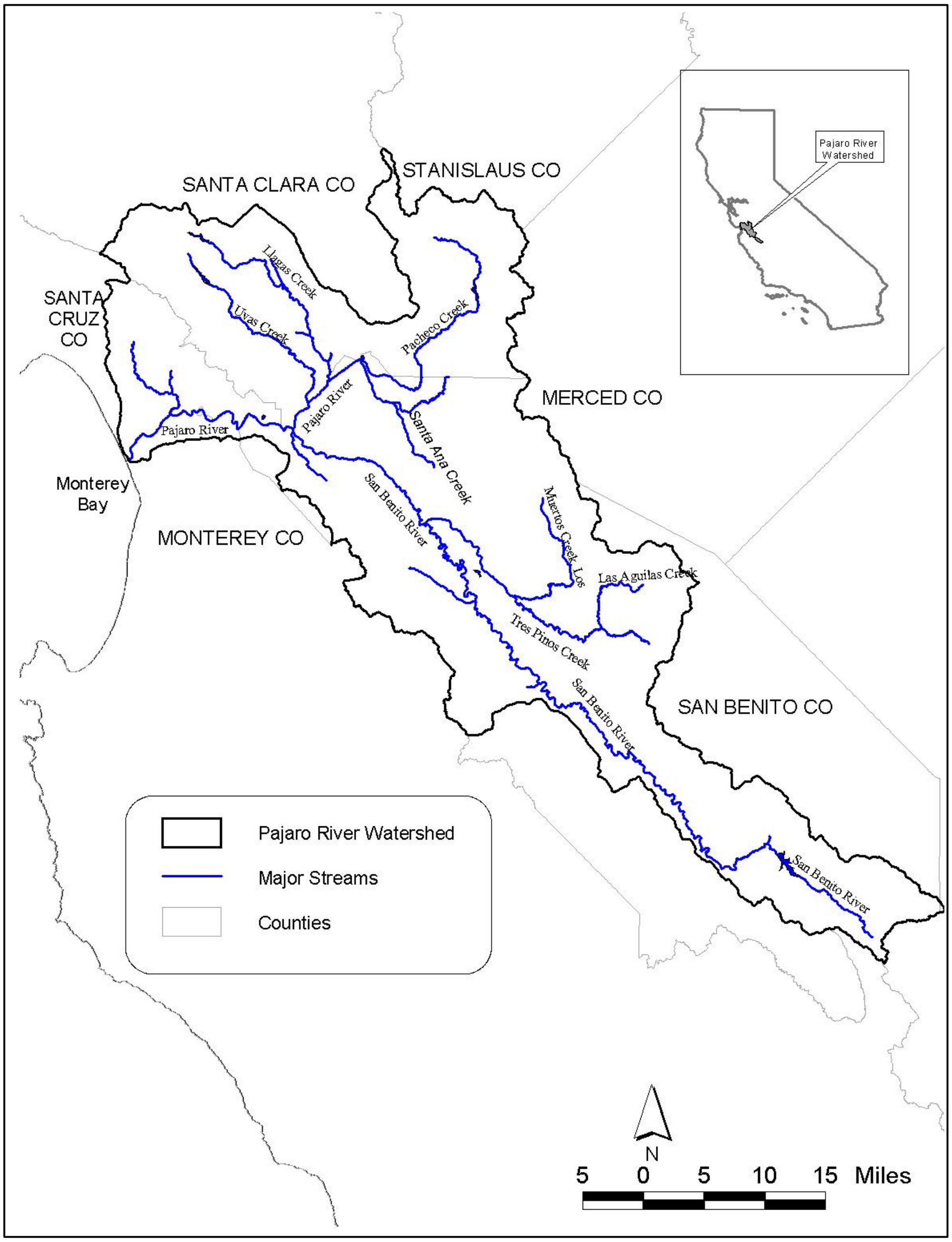

Figure 2-1. Location of the Pajaro River watershed.

2.1 Beneficial Uses

The California Regional Water Quality Control Board (Water Board) is responsible for protecting water resources from pollution and nuisance that may occur as a result of waste discharges. The Water Board determines beneficial uses that need protection and adopts water quality objectives that are necessary to protect the beneficial water uses. The beneficial uses and water quality objectives are contained in the Water Quality Control Plan (Basin Plan).

Indicator bacteria (e.g., fecal coliform and *E. coli)*, are commonly used for predicting the presence of organisms that may be pathogenic (e.g., virus, bacteria, protozoa). If a concentration threshold of indicator bacteria is detected in a sample, pathogenic organisms may also be present. Elevated levels of fecal coliform are an indication that waterbodies may be unsafe for swimming, fishing, or other forms of water contact and non-contact (REC-1 and REC-2) activities. Water contact recreation is the most sensitive water recreation use, i.e. it carries the strictest numeric objectives for indicator bacteria.

The Basin Plan identifies beneficial uses for some of the listed waterbodies included in this analysis. The Pajaro River, San Benito River, Llagas Creek, and Tequisquita Slough have designated beneficial uses in the Basin Plan. The beneficial uses cited in the Basin Plan are listed in Table 2-1.

The Basin Plan also states that surface waterbodies within the region that do not have beneficial uses specifically designated for them are assigned the beneficial uses of “municipal and domestic water supply” and “protection of both recreation and aquatic life.” Staff interpreted this general statement of beneficial uses to encompass MUN, REC-1, REC-2, COLD, and WARM.

Table 2-1. Beneficial uses for Pajaro River, San Benito River, Llagas Creek, and Tequisquita Slough.

Waterbody	Pajaro River	San Benito River	Llagas Creek	Tequisquita Slough
Municipal and Domestic Supply (MUN)	X	X	X	
Agricultural Supply (AGR)	X	X	X	
Industrial Service Supply (IND)	X		X	
Ground Water Recharge (GWR)	X	X	X	X
Water Contact Recreation (REC-1)	X	X	X	X
Non-Contact Water Recreation (REC-2)	X	X	X	X
Wildlife Habitat (WILD)	X	X	X	X
Cold Fresh Water Habitat (COLD)	X		X	
Warm Fresh Water Habitat (WARM)	X	X	X	X
Migration of Aquatic Organisms (MIGR)	X		X	
Spawning, Reproduction, and/or Early Development (SPWN)	X	X	X	X
Preservation of Biological Habitats of Special Significance (BIOL)				
Rare, Threatened, or Endangered Species (RARE)		X	X	
Freshwater Replenishment (FRSH)	X			
Commercial and Sport Fishing (COMM)	X	X	X	X

2.2 Problem Statement

The Pajaro River, San Benito River, Llagas Creek, and Tequisquita Slough were listed in 1998 as impaired waterbodies due to excessive fecal coliform levels. These listings are based on 1997-1998 Central Coast Ambient Monitoring Program (CCAMP) results for fecal coliform. Figure 2-2 shows the four listed waterbodies within the Pajaro River watershed. CCAMP data collection results and additional Water Board sampling data are discussed in Section 4 *Data Analysis*.

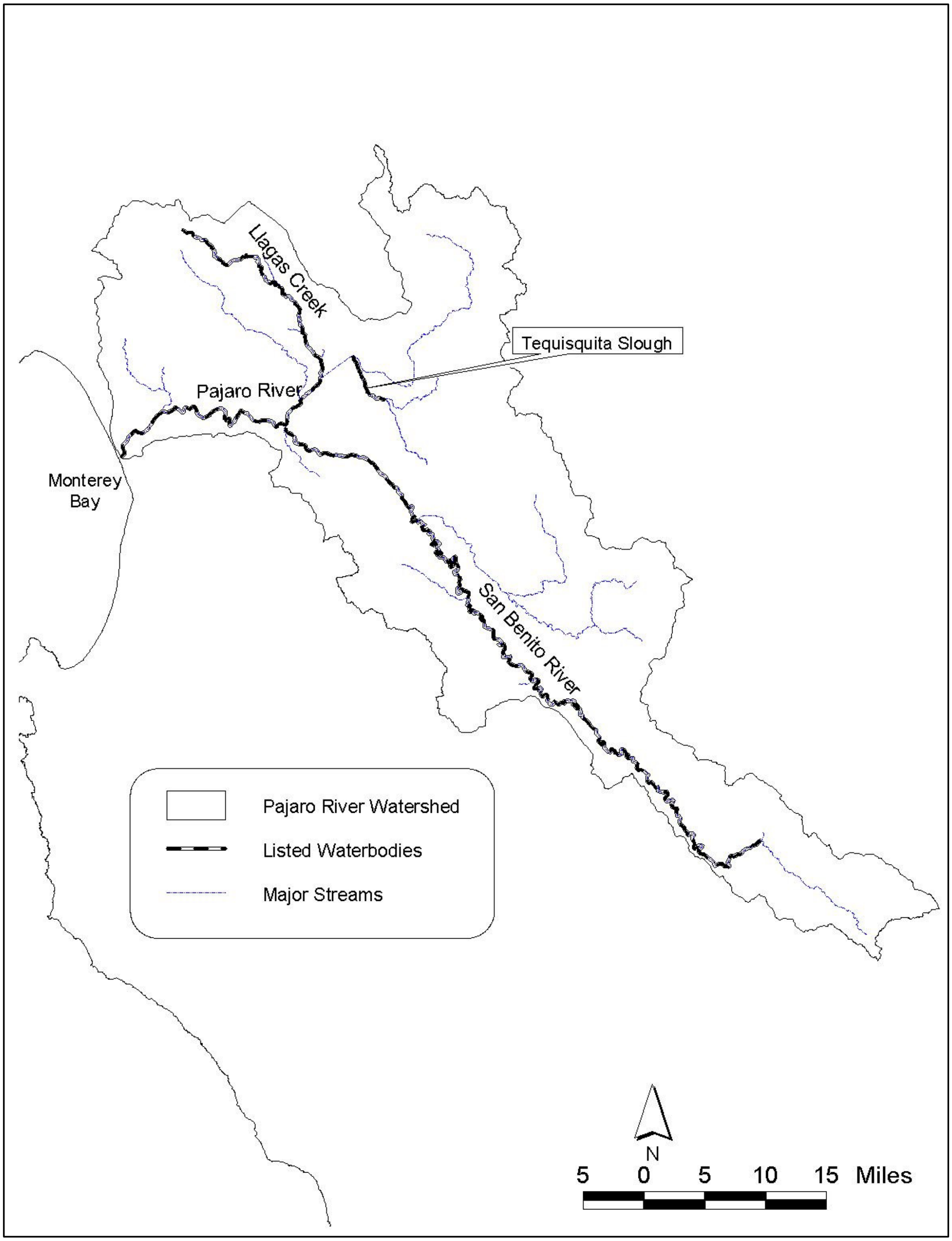

Figure 2-2. Fecal coliform listed waterbodies of the Pajaro River watershed.

3 WATER QUALITY OBJECTIVES

This section describes existing water quality objectives, possible revisions, and U.S. EPA recommended water quality criteria.

3.1 Existing Water Quality Objectives

The Basin Plan states "Controllable water quality shall conform to the water quality objectives contained herein. When other conditions cause degradation of water quality beyond the levels or limits established as water quality objectives, controllable conditions shall not cause further degradation of water quality."

Controllable water quality must conform to the water quality objectives stated in the Basin Plan. The Basin Plan defines controllable water quality conditions as:

> "Controllable water quality conditions are those actions or circumstances resulting from man's activities that may influence the quality of the waters of the State and that may be reasonably controlled."

The Central Coast Region's Water Quality Control Plan (Basin Plan) contains specific water quality objectives that apply to indicator bacteria (Basin Plan, 1994, pg. III-3). These objectives are linked to specific beneficial uses and include water contact recreation and non-contact water recreation as referenced in the following sections.

3.1.1 Water Contact Recreation

The Basin Plan defines water contact recreation as "uses of water for recreational activities involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, swimming, wading, water-skiing, skin and scuba diving, surfing, white water activities, fishing, or use of natural hot springs."

The Basin Plan contains the following objective to protect the water contact recreation beneficial use:

> The fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200-per 100 mL, nor shall more than 10% of samples collected during any 30-day period exceed 400 per 100 mL.[1]

[1] Throughout this document, fecal coliform units are expressed as colony forming unit (CFU), organisms, count (#/100mL or CFU/100 mL) and most probable number (MPN/100mL). All unit expressions are considered equivalent fecal coliform bacteria concentration measures.

E. coli is another indicator bacteria. The Basin Plan does not include water quality objectives for *E. coli*. However, the USEPA recommends *E. coli* not exceed a geometric mean of 126 CFU per 100 mL, generally based on not less than five samples spaced over a 30-day period (U. S. Environmental Protection Agency, *Ambient Water Quality Criteria for Bacteria-1986*, January 1986).

Enterococci are another indicator bacteria. The Basin Plan does not include water quality objectives for enterococci. However, the USEPA recommends enterococci not exceed a geometric mean of 33 CFU per 100 mL in freshwater and 35 CFU per 100 mL for marine waters, generally based on not less than five samples spaced over a 30-day period.

3.1.2 Non-Contact Water Recreation

The Basin Plan defines non-contact water recreation as "uses of water for recreational activities involving proximity to water, but not normally involving body contact with water, where ingestion of water is reasonably possible. These uses include, but are not limited to, picnicking, sunbathing, hiking, beachcombing, camping, boating, tidepool and marine life study, hunting, sightseeing, or aesthetic enjoyment in conjunction with the above activities."

The Basin Plan contains the following objective to protect the non-water contact recreation beneficial use:

> The fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 2000 per 100 mL, nor shall more than 10% of samples collected during any 30-day period exceed 4000 per 100 mL.

3.2 Revision of Water Quality Objectives

The State Water Resources Control Board (State Board) is considering a revision of State recommended water quality objectives for indicator bacteria. Currently, fecal coliform are used as indicators at levels discussed in the previous section. The State Board is considering a revision to incorporate the use of *E. coli* as indicator bacteria at levels recommended by U.S. Environmental Protection Agency (U.S. EPA). Water Board staff will monitor the progress of the State Board effort and, if necessary, adjust the numeric targets of these TMDLs before finalization. USEPA recommended levels for *E. coli* are discussed in the following section.

3.3 U.S. EPA Recommended Water Quality Criteria

The U.S. EPA periodically updates and publishes water quality criteria recommendations. Table 3-1 summarizes U.S. EPA recommended water quality criteria for the protection of human health in recreational waters.

Table 3-1. U.S. EPA recommended criteria for *E. coli*.

Indicator	Risk Level	Geometric Mean Density (per 100 mL)	Single Sample Maximum Allowable Density (per 100 mL)[a]			
			Designated Beach Area (75th percentile)	Moderate Full Body Contact Recreation (82nd percentile)	Lightly Used Full Body Contact Recreation (90th percentile)	Infrequently Used Full Body Contact Recreation (95th percentile)
E. coli	8	126[b]	235	298	409	575

Source: U.S. EPA (1986).
a. Calculated using the following: single sample maximum = geometric mean * 10^(confidence level factor * log standard deviation), where the confidence level factor is: 75%: 0.675; 82%: 0.935; 90%: 1.28; 95%: 1.65. The log standard deviation from EPA's epidemiological studies is 0.4 for fresh waters.
b. Calculated to nearest whole number using equation: geometric mean = antilog_{10} [(risk level + 11.74) / 9.40].

Note that the U.S. EPA water quality criteria are in terms of *E. coli*, whereas the Central Coast Water Board water quality objectives for bacteria are in terms of fecal coliform.

According to USEPA guidance, the preferred criteria level is the geometric mean of 126 MPN/100mL; the single sample maximums are simply statistical extensions of the analysis used to determine the recommended geometric mean density (126 MPN/100mL).

A minimum of five samples collected over a 30-day period is preferred for this calculation. However, in the absence of the five samples in the 30-day period, Lars Wilcut of U.S. EPA suggested that states could elect to batch the samples by season for the calculation (staff communication, February 6, 2007).

4 DATA ANALYSIS

Water Board staff performed data analysis of water quality data, land use data, and the results of bacteria indicator studies from the Central Coast Region. The data analysis is contained as Appendix A.

5 SOURCE ANALYSIS

The purpose of the Source Analysis is to identify sources and assist in allocating appropriate responsibility for actions needed to reduce these sources. Water Board staff relied on water quality and land use data presented in Appendix A, *Data Analysis*, and also considered the following information:

- field observations,
- wastewater spill reports,
- permitted facilities within the watershed,
- monitoring efforts to isolate specific causes of high indicator bacteria loads,
- relationships between seasonal conditions, land use, and indicator bacteria levels,
- connections between land use and indicator bacteria concentrations, and
- connections between land use and genetic sources

Staff also obtained information from representatives of the San Benito County Environment Health Agency, Santa Cruz, Monterey, San Benito and Santa Clara Farm Bureaus, county Resource Conservation Districts, and from individuals who attended the CEQA Scoping meeting that was held June 20, 2007, in Gilroy, California.

5.1 Potential Influence of Land Use Activities on Indicator Bacteria Concentrations

This section discusses the influence of land use activities on indicator bacteria concentrations.

5.1.1 Grazing Lands (Cattle)

Bacterial sources from open spaces that are grazed, in part, originate from cattle feces entering the water body. Staff observed cattle within the San Benito River and cattle grazing adjacent to San Benito River, Pajaro River, Tequisquita Slough, and most tributary streams (e.g. Pachecho Creek, Tres Pinos Creek, San Juan Creek, and Uvas Creek). In addition, the California Food Emergency Response Team (CalFERT) investigation identified *E. coli* O157:H7 in the San Benito River and Pajaro River, with San Benito River water samples that were indistinguishable from the spinach outbreak strain (see Section 1.6, Appendix A and CalFERT, 2007). *E. coli* O157:H7 was also found in cattle feces within the San Benito River watershed.

Staff concluded that cattle grazing lands are a source contributing to exceedances of water quality objectives.

5.1.2 Livestock (Small Animal Operations)

Small livestock operations on rural residences, such as those for horses, chickens, and other farm animals may also contribute bacteria if manure is not properly managed (e.g., retained on site) or if livestock have access to waterways. Staff observed livestock on rural residential areas adjacent to impaired reaches and tributary streams throughout the Pajaro River watershed.

Staff concluded that livestock are a source contributing to exceedance of water quality objectives.

5.1.3 Livestock (Dairies)

Staff reviewed existing permits for dairy operations and interviewed other Water Board staff to determine if smaller, unpermitted dairy operations are within the Pajaro River watershed. Based on this information, staff identified one permitted dairy near Alimias Creek (a tributary to Llagas Creek) and three unpermitted dairy operations near Tequisquita Slough. Staff performed inspections of these facilities. The permitted dairy operation on Alimias Creek has gone out of business and staff will prepare a rescission of waste discharge requirements for this facility. During inspections of the three small unpermitted dairy operations, staff observed waste discharge from one facility and the potential for waste discharge at the other two facilities. Based on these inspections staff and has requested reports of waste discharge from these three dairy operations. Dairy wastewater may contain pollutants that, if discharged to surface waters, land impoundments, or feed crops, may potentially impact water quality.

Staff concluded that dairy operations are a source contributing to exceedance of water quality objectives in Tequisquita Slough.

5.1.4 Irrigated agriculture

Water Board staff considered possible contributions from irrigated agricultural lands because all of the impaired waterbodies are within these fertile productive growing areas. Staff concluded that contributions from irrigated agriculture were insignificant because many agricultural operations use inorganic fertilizers (based on conversations with various agricultural associated organizations and individuals listed at the beginning of Section 4 *Source Analysis*). Staff determined the presence of organic agricultural operations within the watershed and these operations frequently use organic compost that is derived from chicken manure. The chicken manure is composted and processed into chicken pellets that are applied to crops as organic fertilizer. The CalFERT investigation audited a chicken pellet manufacturer that supplied organic compost for a farm in Paicines. The CalFERT audit of chicken pellet *E. coli* levels resulted in no positive test results (CalFERT, 2007).

Staff also considered pathogen loading from farm workers in irrigated agricultural operations. Staff noted porta-potties located in proximity to field workers throughout the Pajaro River watershed during five field investigations conducted between November 2006 and January 2007. Staff investigated the condition of one porta-potty and found it to be clean and well-maintained (December 28, 2006). Thus staff concluded pathogen loading from field workers was insignificant.

Growers in the project area are highly aware of food safety issues; their livelihood depends on providing a crop that is safe for consumers. As such, growers practice methods that minimize the potential of crop contamination (based on conversations with county Farm Bureau representatives).

Staff concluded that irrigated agricultural operations are not a source contributing to exceedance of water quality objectives.

5.1.5 Onsite Sewage Disposal Systems

Human sources of bacteria can originate from failing onsite sewage disposal systems, or septic systems in rural residential areas. Septic systems generally providing a safe and effective means of handling domestic sanitation needs in rural areas. However, many septic systems are located near water bodies where there is evidence of elevated bacteria levels and may impact recreational uses of the water bodies. The Counties of San Benito, Santa Clara, Santa Cruz, and Monterey regulate individual sewage disposal systems within the rural areas of the Pajaro River watershed.

The most important factor for a septic system to function effectively is sufficient depth of unsaturated soil below the leachfield where filtering and breakdown of wastewater constituents can take place. Without adequate separation distance to the water table, groundwater becomes vulnerable to contamination with pathogenic bacteria and viruses, as well as other wastewater constituents. Due to high groundwater levels in the Tequisquita Slough area, mound treatment systems are required to provide adequate vertical distance between the disposal system and ground water.

Staff has not concluded whether or not individual disposal systems are a source of fecal coliform in the Pajaro River watershed. Therefore, staff will continue to evaluate this potential source, as well as invite information pertaining to this project, in an effort to eliminate uncertainties.

5.1.6 *Homeless Encampments*

Homeless persons generate human fecal waste. Staff observed homeless persons and encampments along the Pajaro River and concluded that homeless persons are a source of fecal coliform.

Water Board staff observed human waste on banks of the Pajaro River at Thurwachter Bridge, Main Street Bridge, and at the Betabel Road monitoring site.

Staff also observed blankets and sleeping pads suggesting that people spent the night in these locations.

Because homeless persons and their waste existed within the Pajaro River system, Water Board staff determined it was highly likely that their waste reached surface waters. Staff concluded that that homeless encampments are a source of fecal coliform and actions to reduce fecal coliform from homeless persons in Pajaro River are necessary.

5.1.7 Uncontrollable wildlife

Birds and other wildlife are a source of fecal coliform on each of the land uses present in the project area, particularly in riparian areas. Staff concluded this source contributed to elevated levels of fecal coliform in each of the listed water bodies and from information obtained from the CalFERT investigation (see Section 1.6, Appendix A). Birds and wildlife however, are an uncontrollable source, and staff does not propose implementation actions to reduce loading.

5.2 Potential Influence of Permitted Facilities and Entities on Indicator Bacteria Concentrations

5.2.1 Facilities Subject to Discharge Permits

The Water Board issues Waste Discharge Requirements (WDRs) for several facilities in the Pajaro River watershed. Numerous facilities (e.g. onsite systems for schools, food processing plants) are permitted for discharge to land.

Wastewater treatment facilities in the Pajaro River watershed (City of Hollister, City of Gilroy, City of San Juan Bautista, and City of Watsonville) are authorized to discharge treated municipal wastewater to land where such discharges are likely to percolate to groundwater. Discharge of municipal wastewater to surface water bodies is prohibited. Each municipality is responsible for operation of the collection system. Dischargers will be developing collection system management plans during renewal of their permits.

Staff evaluated information provided by permitting staff at the Water Board. Permitting staff indicated that there was no evidence or indication of bacteria problems due to land discharges, seepage, nor spills in the Project Area. Staff concluded that neither the effluent discharged to land from the wastewater treatment plant, nor the sanitary sewer systems were a source.

Other permitted discharges to surface waters include water supply discharges, fire hydrant testing, and vegetable cooling (ice melt), none of which are likely sources of fecal coliform bacteria in the listed water bodies.
Staff concluded that neither permitted facilities nor the municipal collection systems are sources of fecal coliform in the listed water bodies.

5.2.2 Municipalities Subject to Storm Water Permits

The Water Board regulates storm water discharge through the issuing of National Pollution Discharge Elimination Permits (NPDES) storm water discharge permits to several municipalities in the Pajaro River watershed. The cities of Morgan Hill and Hollister and Monterey County (City of Pajaro) have permit coverage.

Staff evaluated indicator bacteria concentrations in storm water discharges from municipal drains as part of the Water Board Monitoring (see Section 1.5, Appendix A). Staff found elevated levels of *E. coli* from municipal storm water discharges

Staff concluded that municipal storm water discharges are a source of fecal coliform in the listed water bodies. Staff made this conclusion based on Water Board Monitoring results of storm drain discharges.

5.3 Source Analysis Summary

Indicator bacteria levels throughout the Pajaro River watershed were elevated and varied by season, and a multitude of land uses drained to each of the listed water bodies. Despite CCAMP and Water Board sampling efforts, the outcomes did not definitively specify relative sources of fecal coliform from each land use, but rather confirmed that fecal coliform was originating from each of the land uses. As such, staff considered numerous activities associated with all land uses as potential sources.

Table 4-1 shows the summary of identified sources of indicator bacteria in the watershed. Staff listed the identified sources by source category and the source organisms likely contributing to that category.

Table 5-1. Summary of identified sources of indicator bacteria.

Source Category	Source Organism(s)
Grazing Lands	Cattle
Livestock	Examples include: cattle, horses, goats, sheep, chickens.
Homeless Encampments	Humans
Wildlife	Examples include: wild pigs, skunk, opossum, birds (including fowl), and deer.
Municipal Storm Water	Dogs, cats, humans.

Staff has not concluded whether or not individual onsite sewage disposal systems are a source of fecal coliform in the Pajaro River watershed. Therefore, staff will continue to evaluate this potential source.

6 CRITICAL CONDITIONS AND SEASONAL VARIATION

Critical conditions for this project may include the influence of weather, flow, and temperature conditions, but the extent of each potential influence on indicator bacteria conditions is uncertain. The critical conditions or seasonal variations, however, did not influence the TMDLs, allocations or implementation and therefore, recommendations for this project apply during all seasons and address the most critical conditions for indicator bacteria concentrations.

Staff determined that there was a pattern of seasonal variation based on monitoring data. Although impairment in the watershed occurred in all seasons maximum fecal coliform and *E. coli* densities, as well as higher fecal coliform geomean values were observed during the wet season. However, *E. coli* geomean values were generally greater during the dry season.

7 NUMERIC TARGET

A numeric target is a measurable value that, if achieved, will result in attainment of a water quality objective.

The numeric targets for this TMDL are based on both the current Basin Plan objective for fecal coliform and the USEPA recommended concentration for *E. coli*.

The numeric target for generic *E. coli* numeric target is:

The geometric mean density of E. coli shall not exceed 126 MPN/100mL, based on a minimum of not less than five samples collected during any 30-day period.

The numeric target for fecal coliform is:

Fecal coliform concentration , based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200/100mL, nor shall more than ten percent of total samples during any 30-day period exceed 400/100mL.

Table 7-1. Numeric Fecal Coliform and *E. coli* Targets for Pajaro River, San Benito River, Llagas Creek, and Tequisquita Slough.

Fecal Coliform[a]		***E. coli***[b]
Geometric Mean[c]	**Maximum**[d]	**Geometric Mean**[c]
200 MPN/100 mL	400 MPN/100 mL	126 MPN/100 mL

a. Existing Basin Plan Water Quality Objective for Water Contact Recreation Beneficial Use
b. U.S. EPA Ambient Water Quality Criteria for Bacteria-1986
c. Geometric mean of not less than five samples over a period of 30 days
d. Not more than 10% of total samples during a period of 30 days exceed

8 LINKAGE ANALYSIS

The linkage analysis addresses the relationship between pollutant loading (*E. coli*) and water quality response (*E. coli* density, e.g. MPN/100mL). The source analysis and numeric targets address the pollutant in terms of water quality response, and not mass loading. Consequently, the TMDL is expressed in terms of water quality response, and not mass loading.

Therefore, the TMDL demonstrates a linkage between pollutant loading and the resulting water quality response (*E. coli* density) by expressing the TMDL in terms of *E. coli* density.

9 TMDLS CALCULATION AND ALLOCATIONS

A Total Maximum Daily Load (TMDL) is the loading capacity of a pollutant that a water body can accept while protecting beneficial uses. TMDLs can be expressed as loads (mass of pollutant calculated from concentration multiplied by the volumetric flow rate), but in the case of fecal coliform, it is more logical for the TMDL to be based only on concentration. TMDLs can be expressed in terms of either mass per time, toxicity or other appropriate measure [40 CFR §130.2(I)]. A concentration-based TMDL is logical for this situation because the public health risks associated with recreating in contaminated waters is directly related to indicator bacteria concentration, and pathogens are not readily controlled on a mass basis. Therefore, staff proposes establishing concentration-based TMDLs for fecal coliform in the listed water bodies. These TMDLs use the same set of concentrations that are proposed in the numeric targets section (Table 6-1).

Table 9-1. TMDLs for Pajaro River, San Benito River, Llagas Creek, and Tequisquita Slough.

Fecal Coliform [a]	
Log Mean	Maximum
200 MPN/100 mL [b]	400 MPN/100 mL [c]
E. coli [d]	
Log Mean 126 Mean density/100 mL [e]	

a: Source - Regional Water Quality Control Board, Basin Plan 1994.
b Log mean of no less than five samples over a period of 30 days.
c: No more than 10% of total samples during a period of 30 days exceed.
d: Source – U.S. EPA's 1986 bacterial indicator criteria recommendation.
e: Calculated to nearest whole number using equation: geometric mean = antilog_{10} [(risk level + 11.74) / 9.40].

The proposed waste-load and load allocations for all sources (including natural sources) are equal to the TMDL concentration and focus on reducing or eliminating the controllable sources of fecal coliform and *E. coli*. These sources shall not discharge or release a "load" of indicator bacteria, either fecal coliform or *E. coli*, that will increase the load above the TMDL of the water body. All areas of the watershed, including tributaries will be held to these allocations. The parties responsible for the allocation to controllable sources are not responsible for the allocation to natural sources.

The TMDLs are considered achieved when the allocations assigned to the controllable and natural sources are met, or when the numeric targets are consistently met in all water bodies.

9.1 Proposed Wasteload and Load Allocations

Table 8.2 shows wasteload and load allocations to responsible parties associated with the sources of indicator bacteria identified. All the allocations are equal to the TMDLs, which are expressed as receiving water concentrations

Table 9-2. Allocations and Responsible Parties

Responsible Party	**Source Category/ (Load/Wasteload Allocation)**	**Allocation (fecal coliform and E. coli MPN/100mL)**
	Controllable Sources	
Operators or owners of grazing lands	Grazing Lands (Load Allocation)	▪ Equal to the TMDLs
Operators or owners of livestock facilities, dairies, and farm animals	Livestock (Load Allocation)	▪ Equal to the TMDLs
Land owners with homeless encampments	Homeless people (Load Allocation)	▪ Equal to the TMDLs
Cities of Watsonville, Gilroy, Morgan Hill, and Hollister, and Counties of Santa Cruz, San Benito, Santa Clara and Monterey	Municipal Storm Water (Wasteload Allocation)	▪ Equal to the TMDLs
	Uncontrollable Sources	
None	Natural (Load Allocation)	▪ Equal to the TMDLs

Staff has not concluded whether or not individual onsite sewage disposal systems are a source of bacteria indicators within the Pajaro River watershed. Therefore, staff will continue to evaluate this potential source. If staff concludes that individual onsite sewage disposal systems are a source contributing to water quality impairment then load allocations will be assigned and appropriate implementation actions will be recommended.

10 MARGIN OF SAFETY

A TMDL requires a margin of safety component that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving water (CWA 303(d)(1)(C)). For the Pajaro River watershed, a margin of safety has been established implicitly through the use of protective numeric targets.

The uncertainties between the pollutant loading and water quality response stem largely from the uncertainties of sources of indicator bacteria. For example, staff observed fecal material associated with homeless encampments in portions of the watershed, but the level of indicator bacteria loading from homeless encampments was largely unknown.

There is widespread speculation that indicator bacteria may have a longer survival (relative to natural conditions) in nutrient and sediment rich channels holding agricultural return waters. Some stakeholders speculated that indicator bacteria could significantly multiply in nutrient rich sediment. At the time of this report preparation, this speculation could not be defended or refuted, and was therefore an uncertainty.

Although uncertainties exist, the nature of a density (or concentration) based TMDL and allocations account for uncertainties insofar as indicator bacteria loading, from known and unknown sources alike, cannot be such that the resulting water quality exceeds the TMDL. This approach, along with adaptive management strategy towards achieving the TMDL, accounts for the nexus between pollutant loads and resulting water quality.

The fecal coliform and *E. coli* numeric targets were set equal to the Basin Plan and U.S. EPA recommended levels, respectively. USEPA recommended levels for *E. coli* were established with the knowledge of predicted and acceptable risk of the recommended level. Since the numeric targets were set equal to these USEPA recommended *E. coli* levels, and the recommended levels carry calculated and acceptable risk, the TMDL has an implicit margin of safety.

11 IMPLEMENTATION ALTERNATIVES

11.1 Introduction

The purpose of a TMDL Implementation Plan (Plan) is to describe the steps necessary to reduce loads and achieve the TMDLs. Staff identified implementation alternatives that will likely be included in the Plan. This section includes potential implementation alternatives that staff expects would reduce indicator bacteria loading and the parties that would be responsible for taking these actions. These are discussed below. Interim actions that could be taken during TMDL development are also discussed. The Implementation Plan will ultimately include specific actions and a timeline to achieve the TMDLs.

11.2 Alternatives

In developing preliminary implementation alternatives for this project, Water Board staff considered existing efforts in the watershed and requirements that have been outlined in other TMDLs. Staff identified possible implementation actions or alternatives for all sources (e.g. storm water, agriculture, grazing) that may be contributing to the impairment.

Water Board staff recognized numerous existing efforts and regulatory mechanisms aimed at reducing indicator bacteria loading. These included, but are not limited to the following: farmers and ranchers implementing irrigated agricultural and grazing management measures, rural landowners maintaining individual sewage disposal systems and implementing management measures to control livestock wastes, and municipalities implementing storm water management measures. Potential implementation alternatives are described for each source category below.

Implementation actions and monitoring requirements are likely to rely on existing and proposed regulatory mechanisms. For example, nonpoint sources of bacteria, such as grazing and livestock, will be required to implement Nonpoint Source Implementation Control Programs to comply with WDRs, waivers, or prohibitions; while municipalities will be required to comply with the General Permit for Stormwater Discharges by implementing Stormwater Management Plans.

Staff recommends the following actions be developed or modified as part of TMDL implementation to address bacteria indicator loading:

- For grazing lands and livestock: Implement and photo-document management measures, such as manure management measures, present Ranch Water Quality Plans developed as part of Water Quality short-courses, etc.
- For Homeless Encampments: The City of Watsonville and County of Monterey (City of Pajaro) should identify and implement management measures in an effort to eliminate human waste from entering surface waters.
- For Rural Residential Onsite Sewage Disposal Systems: Evaluate on-site wastewater treatment systems (septic) to determine if management plans are necessary.
- For Municipal Storm Water: Implement indicator bacteria reduction management measures in Storm Water Management Plans for the Cities

of Watsonville, Gilroy, Morgan Hill, and Hollister, and Counties of Santa Cruz, San Benito, Santa Clara and Monterey.

11.3 TMDL development recommendations

In addition to the implementation alternatives mentioned in the previous section, staff identified actions that could be taken pro-actively during TMDL development. These are described below. If these actions are not taken prior to TMDL adoption, they may be required through modifications to existing regulatory mechanisms or new regulatory mechanisms. The actions and regulatory mechanisms to require the actions would be included in the Plan.

- For Homeless Encampments: The City of Watsonville and County of Monterey (City of Pajaro) should amend their Phase II Storm Water Management Plan to address human sources of fecal coliform that is contributed by homeless encampments.
- For municipal storm water: Municipalities with approved Phase II Phase II Storm Water Management Plans [the cities of Morgan Hill and Hollister and Monterey County (City of Pajaro)] and municipalities seeking permit coverage (Santa Cruz County, Santa Clara County, and the cities of Gilroy and Watsonville) should establish monitoring stations and collect water quality data as necessary (e.g. waters that flow through municipal areas into waters within the Pajaro River Watershed) during storm events and during dry season flows (when present).
- For Rural Residential Onsite Sewage Disposal Systems: The Counties of Santa Cruz, San Benito, Santa Clara and Monterey should survey septic systems for potential leaks and failures.

12 MONITORING

Any responsible parties required to implement actions as listed above, may also be required to conduct monitoring. Any monitoring requirements will be described in the regulatory mechanisms used to require implementation actions (e.g., permits, and/or regulatory mechanisms consistent with the NPS policy).or through other mechanisms to require monitoring (e.g., monitoring orders issued by the executive officer pursuant to Section 13267 of the CA Water Code). Monitoring may also be conducted by third party, technical assistance or nonprofit organizations through grant funds. Staff anticipates that the following types of monitoring will be required:

- Indicator bacteria monitoring of all waterbodies with TMDLs established.
- Monitoring of management measures aimed at achieving the allocations and TMDL (e.g., implementation progress and effectiveness).

Water Board staff will conduct triennial reviews of implementation progress and water quality monitoring data to assess progress towards achieving the TMDL.

13 PUBLIC PARTICIPATION

The primary goals of stakeholder involvement in the Pajaro River Watershed are to learn about existing implementation efforts and available information (e.g. water quality data), to communicate TMDL project status to agency staff and individuals, to coordinate additional data collection, to gain support for the potential implementation strategies, and to develop additional monitoring activities.

The primary framework for stakeholder involvement to date has been email and phone correspondence, staff participation in an existing group's meetings (e.g. a farm water quality short-course) and focused meetings to request specific information (e.g. water quality data) or to answer specific questions (e.g. regarding implementation approaches).

Staff conducted a California Environmental Quality Act (CEQA) stakeholder scoping meeting on June 20, 2007. Staff addressed questions and comments from attendees.

Staff intends to hold another public participation meeting in the fall of 2007.

Staff will also inform stakeholders of their right to submit written comment during the formal comment period before the Regional Board hearing of the TMDL.

14 PROJECT STATUS

The State of California's guidance for addressing impaired waters (Process for Addressing Impaired Waters in California, June 2005) describes eight phases for addressing impaired waters. These eight phases are referred to as:

1. Phase-1; Project Definition
2. Phase-2; Project Planning
3. Phase-3; Data Collection
4. Phase-4; Project Analyses
5. Phase-5; Regulatory Action Selection
6. Phase-6; Regulatory Process
7. Phase-7; Approval
8. Phase-8; Implementation.

Development of the TMDLs for Fecal Coliform in the Pajaro River Watershed is currently in Phase Four, Project Analyses, which ends with the completion of this document, the Final Preliminary Project Report.

Staff will develop a Draft Report, which will be the first report associated with Phase 5-Regulatory Action Selection. The Draft Report will contain draft technical analysis and recommendations for implementing the TMDL. Staff anticipates the Draft Report will be completed in October 2007.

The Final Project Report, the last report of Phase-5, contains the elements that will be presented to the Central Coast Water Board for TMDL approval. Staff anticipates that the Final Project Report will be completed in the spring of 2008. Finally, staff anticipates that the Central Coast Water Board hearing (to consider approval of the TMDL) will be in July 2008.

Staff held a California Environmental Quality Act (CEQA) scoping and public participation meeting in June 2007. Stakeholders presented comments to staff at the meeting regarding the Project in general, as well potential environmental impacts of the Project. Staff plans to hold another public outreach meeting upon the completion of the Draft Report (anticipated in October 2007). In addition, the public will have an opportunity to formally comment on the Project before the Water Board Hearing (anticipated in July 2008).

Readers of this document should be aware that uncertainties regarding the Project still exist. Staff has attempted to alert the reader in the sections where these uncertainties lie.

As always, we invite the public to share information with staff regarding the project. Your concerns and ideas for and about improving water quality in our waters are invited, and are not limited to public outreach meetings or formal comment periods. Please see the staff contact person information on the cover page of this report if you believe you have information that would be valuable to this Project.

15 REFERENCES

California Food Emergency Response Team (CalFERT). 2007. Investigation of an Escherichia coli O157:H7 Outbreak Associated with Dole Pre-Packaged Spinach. March 21, 2007. Accessed March 23, 2007 at http://www.dhs.ca.gov/ps/fdb/local/PDF/2006%20Spinach%20Report%20Final%20redacted.PDF

State Water Resources Control Board. 2004. Policy for implementation and Enforcement of the Nonpoint Source Pollution Control Program May 20, 2004.

U.S. Environmental Protection Agency. 1986. Ambient Water Quality Criteria for Bacteria – 1986. EPA440/5-84-002.

U.S. Environmental Protection Agency. 2002. Implementation Guidance for Ambient Water Quality Criteria for Bacteria, May 2002 Draft. EPA-823-B-02-003.

Water Quality Control Plan, Central Coast Region. 1994.

Appendix A

Data Analysis

1 DATA ANALYSIS

1.1 Background on fecal indicator bacteria

The Central Coast Ambient Monitoring Program (CCAMP) assesses the presence of bacterial indicators by analyzing total and fecal coliform bacteria in grab samples. The total coliform group of bacteria is from the family, *Enterobacteriaceae*, which includes over 40 genera of bacteria. Bacteria of both fecal and non-fecal origin are included in the total coliform group. Common habitats for the group include soil, groundwater, surface water, the intestinal tract of animals and humans, the surface of plants, algal-mats in pristine streams, wastes from the wood industry, and biofilms within drinking water distribution systems (Hurst, et al., 2002). The total coliforms can be divided into various groups based on common characteristics. Among these, the fecal coliforms are generally indicative of fecal sources, though not all members of the group are of fecal origin (Hager, et al, 2004, p. 6). The bacteria species, *Escherichia coli (E. coli)*, comprises a large percentage of coliform detected in human and animal feces. Some strains of *E. coli* are pathogenic and some are not.

Analysis of water samples to detect the presence of fecal coliform and/or *E. coli* is one way to determine the potential presence of pathogens. However, analytical methods for quantifying bacteria lack the precision common to many other laboratory methods for water quality analysis. For example, the Multiple Tube Fermentation[1] method results in an estimate of the most probable number (MPN) of bacteria. This number varies considerably and for a given result of 1,600 MPN/100mL for example, the 95% confidence limit ranges from 600 to 5,300 MPN/100mL. The other common method, Membrane Filtration, also has limitations, such as potentially under representing the concentration of coliform, particularly with highly turbid samples. In spite of these analytical limitations, testing for fecal coliform and/or *E. coli* is one of the best available methods to indicate potential fecal contamination (Hager, p. 7).

Genetic ribotyping is a microbiological source tracking method that differentiates animal *E. coli* from other sources of animal *E. coli*. This tracking method identifies the animals from which *E. coli* originate and an estimate of relative contribution; however it does not provide the geographic locations or land uses where the animals reside or how the *E. coli* was transported from the animal to the waterbody. Central Coast Water Board staff (staff) considered ribotyping results as an <u>estimate</u> of possible sources and of relative source contributions among all of the various sources. Ribotyping represents one of the "lines of evidence" in determining source contribution.

[1] when referring to Multiple Tube Fermentation, staff is including both the conventional multiple tube method and IDEXX's colilert trays.

The levels of fecal coliform and *E. coli* detected during this study indicated that the Pajaro River, San Benito River, Llagas Creek, and Tequisquita Slough watersheds have a bacterial problem throughout most of their system. The following discussion addresses where and to what degree the problem occurs, along with a review of microbial source tracking results that may be transferable to these watersheds.

1.2 Exceedance of Water Quality Objectives and Criteria

Staff evaluated water quality data based on existing Basin Plan water quality objectives and U.S. EPA recommended criteria. The most stringent water quality objectives and criteria are those protecting water contact recreation. Therefore, exceedance is defined as excursion of either of the following:

Fecal coliform concentration, based on a minimum of not less than five samples for any 30-day period, shall not exceed a log mean of 200 per 100ml, nor shall more than 10% of total samples during any 30-day period exceed 400 per 100ml.

Geometric mean density shall not exceed 126 E. coli MPN/100ml.

No single sample shall exceed 409 E. coli MPN/100ml.

The Basin Plan water quality objective is expressed in terms of fecal coliform for the protection of water contact recreation. However, the data required to evaluate exceedance of both the geomean and single sample maximum fecal coliform objective (five samples in 30-day period) was not available because samples were typically taken only once a month. Therefore, a direct evaluation of Basin Plan fecal coliform water quality objective exceedances can not be made. However, for the purpose of this data analysis, and to provide a general indication of fecal coliform water quality conditions, water quality data is presented in terms of geometric mean and single sample maximum then subsequently compared to the Basin Plan water quality objectives. Staff used a minimum sample size of five to evaluate geomean and single sample maximum data for both fecal coliform and *E. coli.*

A seasonal representation of fecal coliform data is provided in the following sections, where the wet period is from November 1 to April 30 and the dry period is from May 1 to October 31. Staff conducted an analysis of seasonal data to evaluate critical conditions that may occur seasonally and appropriate numeric targets that may be applied on a seasonal basis to attain water quality objectives.

Staff used the U.S. EPA recommended criteria for *E. coli* geometric mean density of no greater than 126 *E. coli* MPN/100mL to evaluate exceedances on a seasonal (wet-dry) basis. In addition, staff used the single sample maximum value of 409 *E. coli* MPN/100mL to compare *E. coli* data with the U.S. EPA recommended criteria for lightly used full body contact recreation. The single sample maximum values were used to provide a general indication of water quality conditions throughout the watershed.

U.S. EPA does not designate specific water contact beneficial uses to the waterbodies in the Project area, leaving Water Board staff to determine the likelihood of each beneficial use. Central Coast Water Board staff has conducted reconnaissance and monitoring activities for two years in the Project area and has not witnessed any full body water contact recreation in any of the waterbodies addressed in this Project. However, it is possible that some water contact recreation is occurring, even if infrequent. Therefore, staff used the U.S. EPA recommended single sample maximum value of 409 *E. coli* MPN/100mL to evaluate exceedance of the lightly used full body contact recreation criteria.

In accordance with the Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List (Listing Policy), staff only considered data that contained five or more samples for each monitoring site when conducting the data analysis. Note that single sample maximum values are generally referred to as maximum values throughout this document.

Staff compared water quality data to these objectives and criteria. Data for individual waterbodies are presented in Sections 1.4 and 1.5.

In summary, high levels of indicator bacteria were observed in portions of all waterbodies indicating that the water contact recreation beneficial use is not protected.

1.3 Data and Information Evaluated

Staff contacted the following agencies and parties to determine if bacteriological data was available for surface waters within the Pajaro River watershed (including tributaries):

- Pajaro Valley Water Management Agency, Jonathan Lear
- San Benito County Water District, Jeff Cattaneo
- Santa Clara County Water District, Carol Presley
- University of California, Santa Cruz, Marc Los Huertos
- South County Regional Wastewater Authority, Saeid Vaziry

Based on these information provided by these contacts, staff determined that additional bacteriological water quality data was not available. Therefore, the only data included in this preliminary analysis is from CCAMP and Water Board monitoring. The following sections provide a summary of the monitoring activities and present the results from these two efforts.

In addition to the water quality data, staff also considered data to determine sources of impairment by indicator bacteria. This included land use data, staff field observations, the results of genetic ribotyping analysis from other Central Coast projects, and information provided by Water Board staff who work in other programs (e.g., permitting, storm water, and non-point source).

1.4 CCAMP Data

The CCAMP conducted two periods of water quality monitoring within the Pajaro River watershed, from 1997-1998 and from 2005-2006. The first sampling period (1997-1998) included fecal coliform results only while the second sampling period (2005-2006) included both fecal coliform and *E. coli* results. It is important to note that additional monitoring sites were added to the 2005-2006 sampling round. Table 1 summarizes the sampling results for both periods and Figure 1 shows the CCAMP monitoring locations used for this data analysis and. Detailed CCAMP data is contained as Attachment 1.

Table 1. CCAMP Monitoring Sites.

Site ID	Site Name
BRI	305BRI-San Benito River @ Hwy 25 d/s Willow Creek
CAN	305CAN-Carnadero Creek @ Private Property Access
CHE	305CHE-Llagas Creek @ Chesbro Reservoir
CHI	305CHI-Pajaro River @ Chittenden Gap
COR	305COR-Salsipuedes Creek d/s of Corralitos Creek
OR2	305COR2-Upper Corralitos Creek
FRA	305FRA-Miller's Canal @ Frazier Lake Road
FUF	305FUF-Furlong Creek @ Fraiser Lake Road
HOL	305HOL-Llagas Creek @ Holsclaw and Leavesley Roads
HSA	305HSA-Harkins Slough @ San Andreas Road
LLA	305LLA-Llagas Creek @ Bloomfield Avenue
LUC	305LUC-Llagas Creek @ Luchessa Avenue/Southside Drive
MON	305MON-Llagas Creek @ Monterey Road
MUR	305MUR-Pajaro River @ Murphy's Crossing
OAK	305OAK-Llagas Creek @ Oak Glen Avenue
PAC	305PAC-Pacheco Creek @ San Felipe Road
PAJ	305PAJ-Pajaro River @ Betabel Road
PES	305PES-Pescadero Creek
PJP	305PJP-Pajaro River @ Main Street
SAF	305SAF-Santa Ana Creek @ Fallon Road
SAN	305SAN-San Benito @ Y Road
SBA	305SBA-San Benito River above unknown tributary
SJN	305SJN-San Juan Creek @ Anzar
TES	305TES-Tequisquita Slough
THU	305THU-Pajaro River @ Thurwachter Bridge
TRE	305TRE-Tres Pinos Creek
UVA	305UVA-Uvas Creek @ Bloomfield Avenue
VIS	305VIS-Llagas Creek @ Buena Vista Avenue

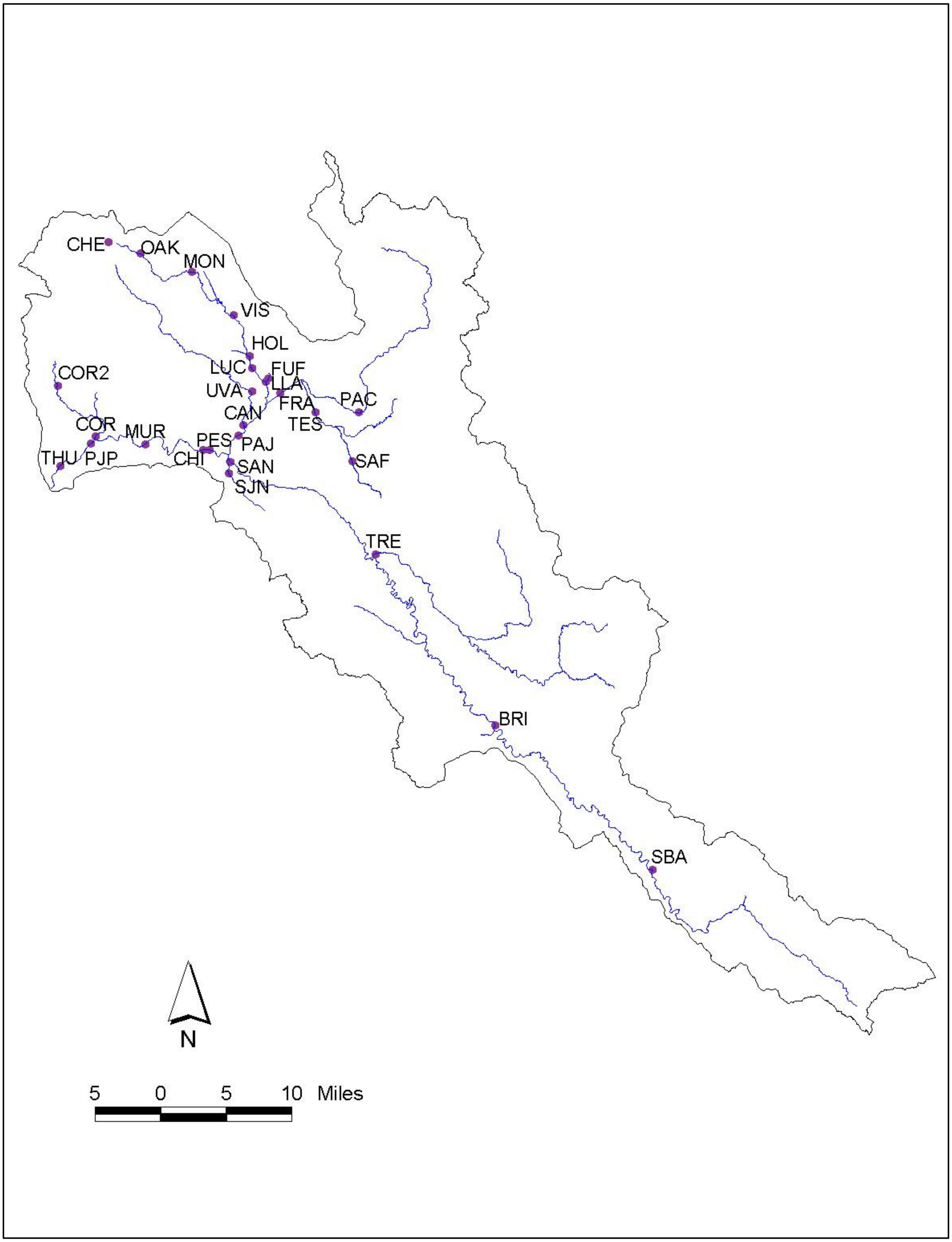

Figure 1. CCAMP monitoring locations.

Table 2. Summary of CCAMP data (1997-1998 and 2005-2006).

Site ID	Fecal Coliform No. Samples	Fecal Coliform Maximum *	Fecal Coliform %>400 *	Fecal Coliform Geomean *	E. coli No. Samples	E. coli Maximum*	E. coli Geomean *
305THU	59	54000	30	236	16	7500	80
305PJP	24	9000	20	188	15	11000	102
305MUR	25	50000	20	212	15	4600	81
305CHI	47	90000	25	239	15	13000	100
305PAJ	37	16000	27	266	15	2900	168
305FRA	25	24000	60	424	15	3000	159
305COR	27	5000	37	336	15	1600	170
305COR2	11	30000	18	177	11	13000	108
305PES	1	900	100	900			
305SAN	26	50000	54	635	14	61000	473
305SJN	15	160001	73	902	15	130000	377
305TRE	17	160000	35	401	7	160000	1066
305BRI	15	90000	47	581	15	2000	255
305SBA	1	50000	100	50000	1	61000	61000
305CAN	16	2400	37	387	16	1300	132
305UVA	17	3000	18	169	10	170	72
305LLA	37	5000	43	403	15	930	172
305LUC	10	3000	50	586			
305HOL	15	16000	40	291	7	1800	179
305VIS	3	900	67	316			
305MON	10	300	0	125			
305OAK	10	500	10	91			
305TES	12	24000	92	4153			
305SAF	1	24000	100	24000	1	20000	20000
305PAC	27	1400	41	272	15	1200	154
305FUF	15	90000	47	837	14	69000	655
305HAR	14	11000	64	1103	14	8300	753
305STL	13	700	7	88	12	240	50
305WSA	12	30000	33	347	10	41000	210

* Values expressed as Most Probable Number (MPN) per 100ml.

Table 2 summarizes fecal coliform and *E. coli* data for each CCAMP site, including the number of samples, maximum values, geomean values, and percent of fecal coliform values over 400 MPN/100ml. Results for wet and dry seasons are presented in later sections of this report.

Please note that Table 2 includes monitoring results for Watsonville Slough (sites 305HAR, 305STL, and 305WSA) and Corralitos Creek (sites 305COR and 305COR2) as background information only. These two waterbodies are tributary to the Pajaro River, however monitoring results from these five sites are not included as part of this data analysis because separate fecal coliform TMDLs are being developed. Stations 305PES, 305SBA, 305VIS, and 305SAF do not meet the minimum sample number of five and therefore are not comparable to either fecal coliform or *E. coli* water quality objectives.

Figure 2 (next page) shows maximum and geomean fecal coliform values for all samples obtained during the two CCAMP monitoring periods. Monitoring locations are on the x-axis with fecal coliform values along the y-axis. The solid horizontal line represents the single sample maximum fecal coliform water quality objective value of 400 MPN/100ml and the dashed horizontal line represents the geomean (log mean) fecal coliform water quality objective of 200 MPN/100ml. Downstream locations along the Pajaro River are depicted on the left side of the x-axis (305THU through 305FRA), with 305THU representing a location near the mouth of the Pajaro River. Tributary streams are represented in the order in which they meet with the Pajaro River, beginning with Corralitos Creek (305COR, 305COR2), Pescadero Creek (305PES), and San Benito River stations (305SAN through 305SBA). It is important to note that the graph below depicts sites for Watsonville Slough (305HAR, 305STL, and 305WSA) and Corralitos Creek (305COR, 305COR2), which are not a part of this data analysis, as separate fecal coliform TMDLs will be developed for these waterbodies. Please refer to Figure 1 for monitoring site locations and Table 1 for site descriptions.

Fecal coliform maximum values exceed water quality objectives at all stations except for the upper portion of Llagas Creek (305MON). The highest maximum values are found at San Juan Creek (305SJN) which is tributary to Pajaro River and at Tres Pinos Creek (305TRE), a tributary to San Benito River.

Fecal coliform geomean values exceed water quality objectives at all stations except for Pajaro River at Main Street (305PJP), Uvas Creek (305UVA), and the two stations of upper Llagas Creek (305OAK and 305MON). The highest geomean value was observed at San Juan Creek (305SJN), tributary to Pajaro River. Note that geomean results for monitoring stations 305PES, 305SBA, 305VIS, and 305SAF do not meet the minimum sample size of five and therefore are not comparable to water quality objectives.

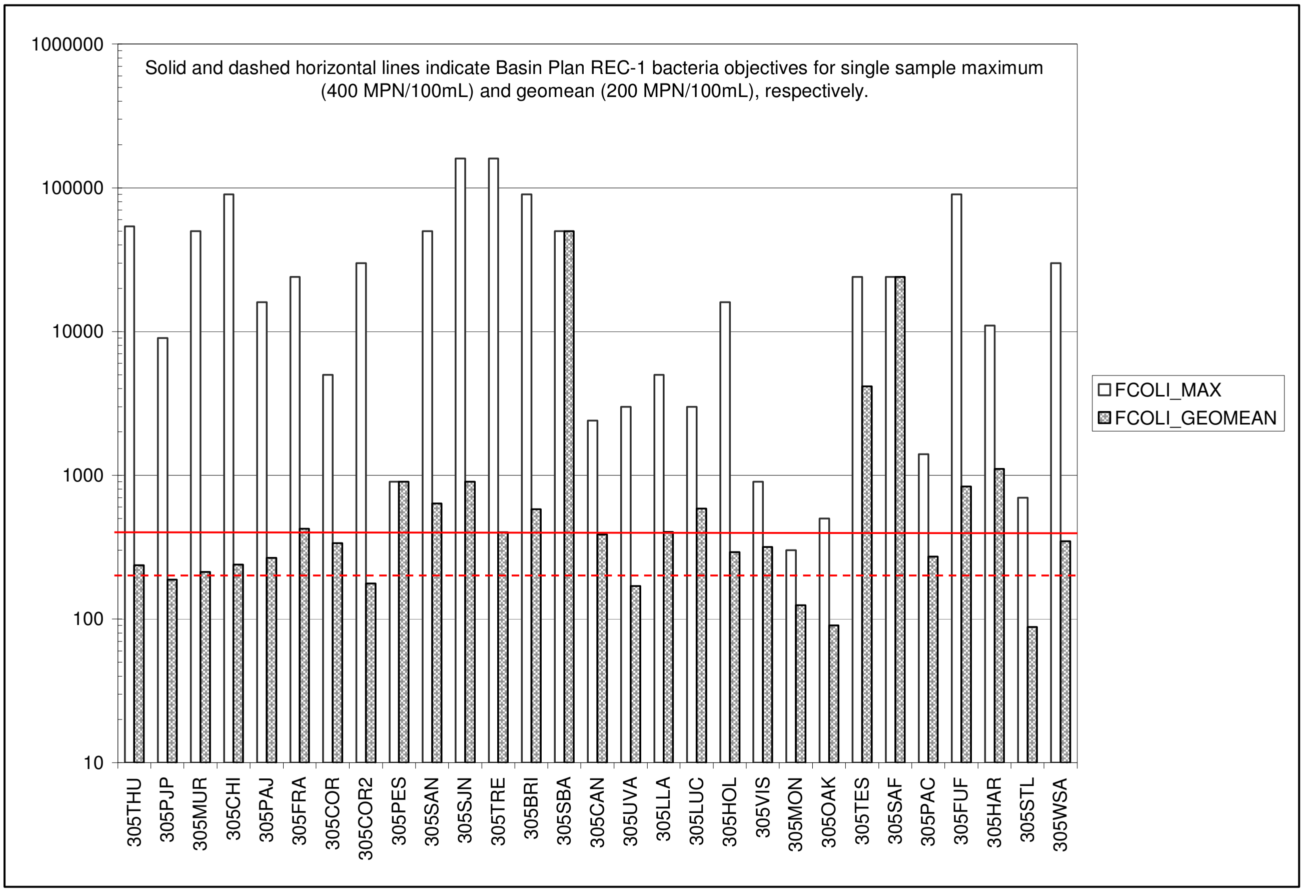

Figure 2. CCAMP maximum and geomean fecal coliform results (1997-1998 and 2005-2006).

Figure 3 shows fecal coliform maximum wet season values (November-April) and maximum dry season values (May-October). Wet season values are generally greater than dry weather values for all stations with the exception of stations located along Uvas Creek (305CAN and 305UVA), lower Llagas Creek (305LLA through 305HOL and 305FUF), upper Llagas Creek (305OAK) and the Pachecho Creek station (305PES). The sampling station on upper Llagas Creek (305MON) met water quality objectives for both seasons.

Note that results for monitoring stations 305PES, 305SBA, 305VIS, and 305SAF do not meet the minimum sample size of five for either season and are therefore not comparable to fecal coliform water quality objectives.

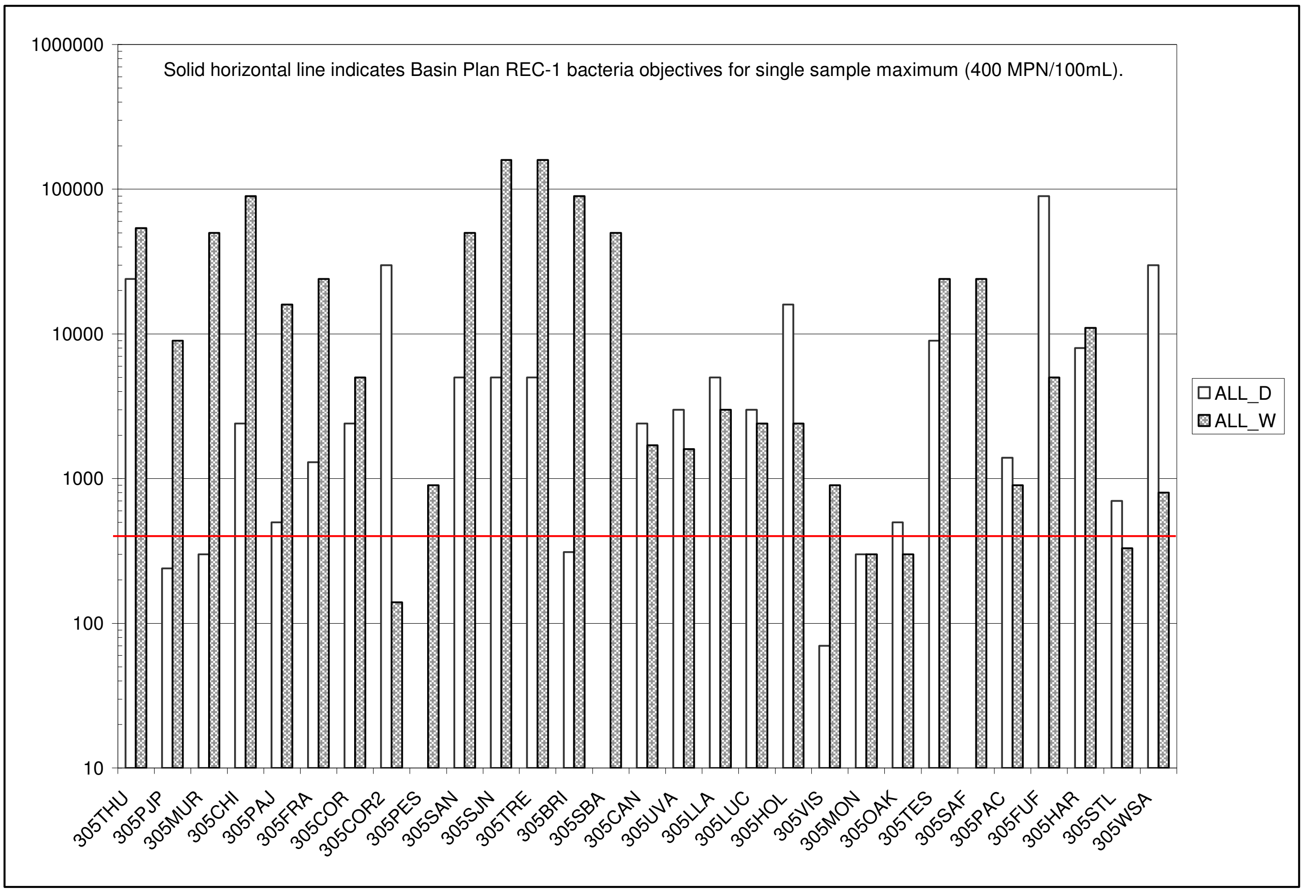

Figure 3. CCAMP maximum fecal coliform values based on wet (Nov -Apr) and dry (May-Oct) seasons (1997-1998 and 2005-2006).

Figure 4 shows CCAMP fecal coliform geomean values based on wet season (November-April) and dry season (May-October) values. Wet season geomean values are greater for all stations located along lower Pajaro River (305THU through 305PAJ) and dry weather values do not exceed the water quality objectives. The site at Millers Canal and Frazier Lake Road (305FRA), representing flow from San Felipe Lake to upper Pajaro River, had a greater geomean value during the dry season as did a majority of the other sampling locations within the watershed.

Two sites of upper Llagas Creek (305MON and 305OAK) achieved water quality objectives during both wet and dry seasons.

Note that geomean results for monitoring stations 305TRE, 305SBA, 305UVA, 305HOL, 305VIS, and 305SAF do not meet the seasonal minimum sample size of five and therefore are not comparable to fecal coliform water quality objectives.

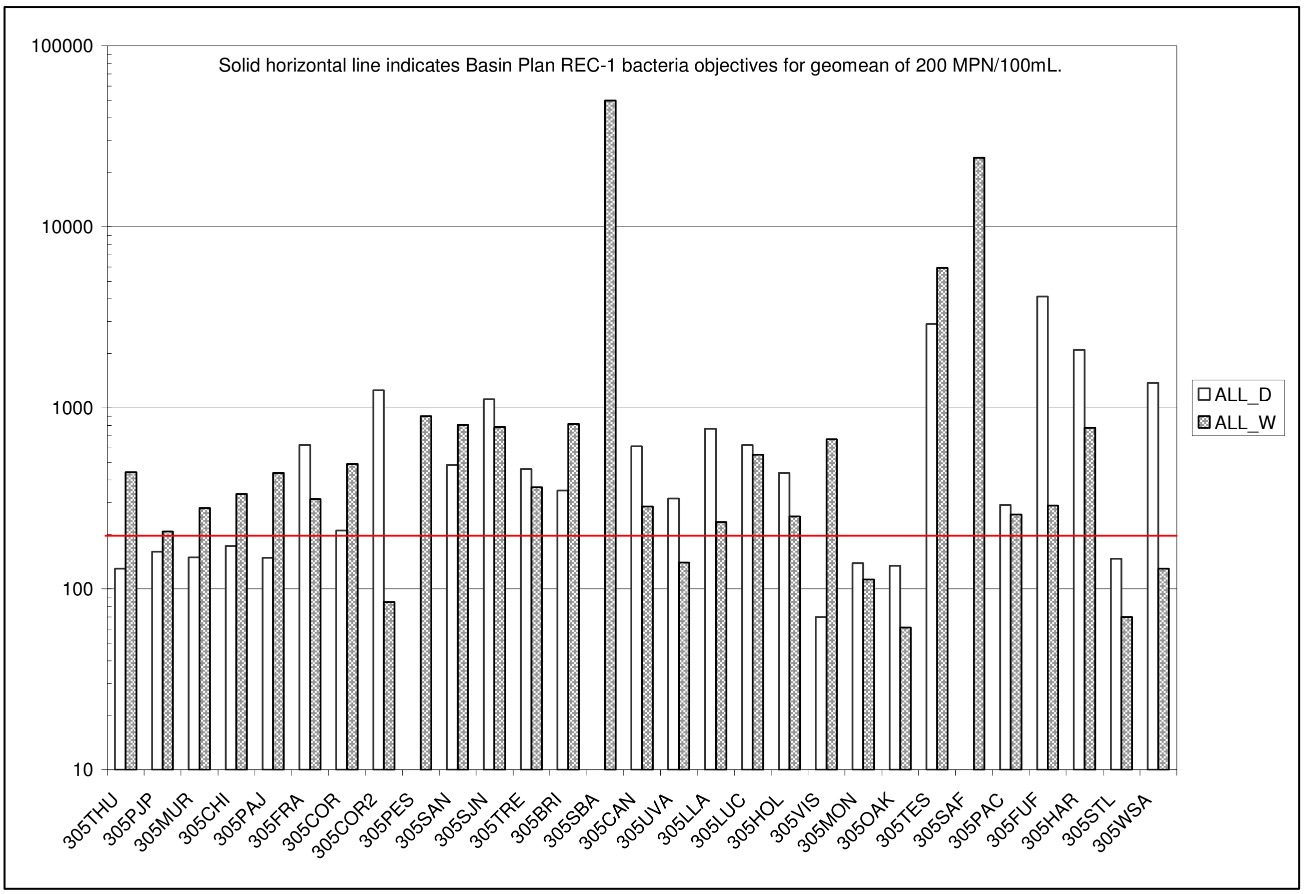

Figure 4. CCAMP geomean fecal coliform values based on wet (Nov -Apr) and dry (May-Oct) seasons (1997-1998 and 2005-2006).

Figure 5 shows the maximum and geomean *E. coli* values for all samples obtained during the two CCAMP monitoring periods. Note that data was not obtained for some sampling sites. The solid horizontal line represents the EPA-recommended single sample maximum *E. coli* value of 409 MPN/100ml for protection of lightly used full body contact recreation and the dashed horizontal line represents the EPA-recommended geomean value of 126 MPN/100ml.

Maximum *E. coli* values exceeded the water quality objective at all sites maximum except Uvas Creek (305UVA). Note that sites 305SBA and 305SAF do not meet the minimum sample size of five and therefore are not comparable to single sample maximum water quality objectives.

E. coli geomean values are generally exceeded at all monitoring sites with the exception of the lower Pajaro River sites (305THU, 305PJP, 305MUR) and Uvas Creek sites (305CAN and 305UVA). Note that sites 305SBA and 305SAF do not meet the minimum sample size of five and therefore are not comparable to *E. coli* geomean water quality objectives.

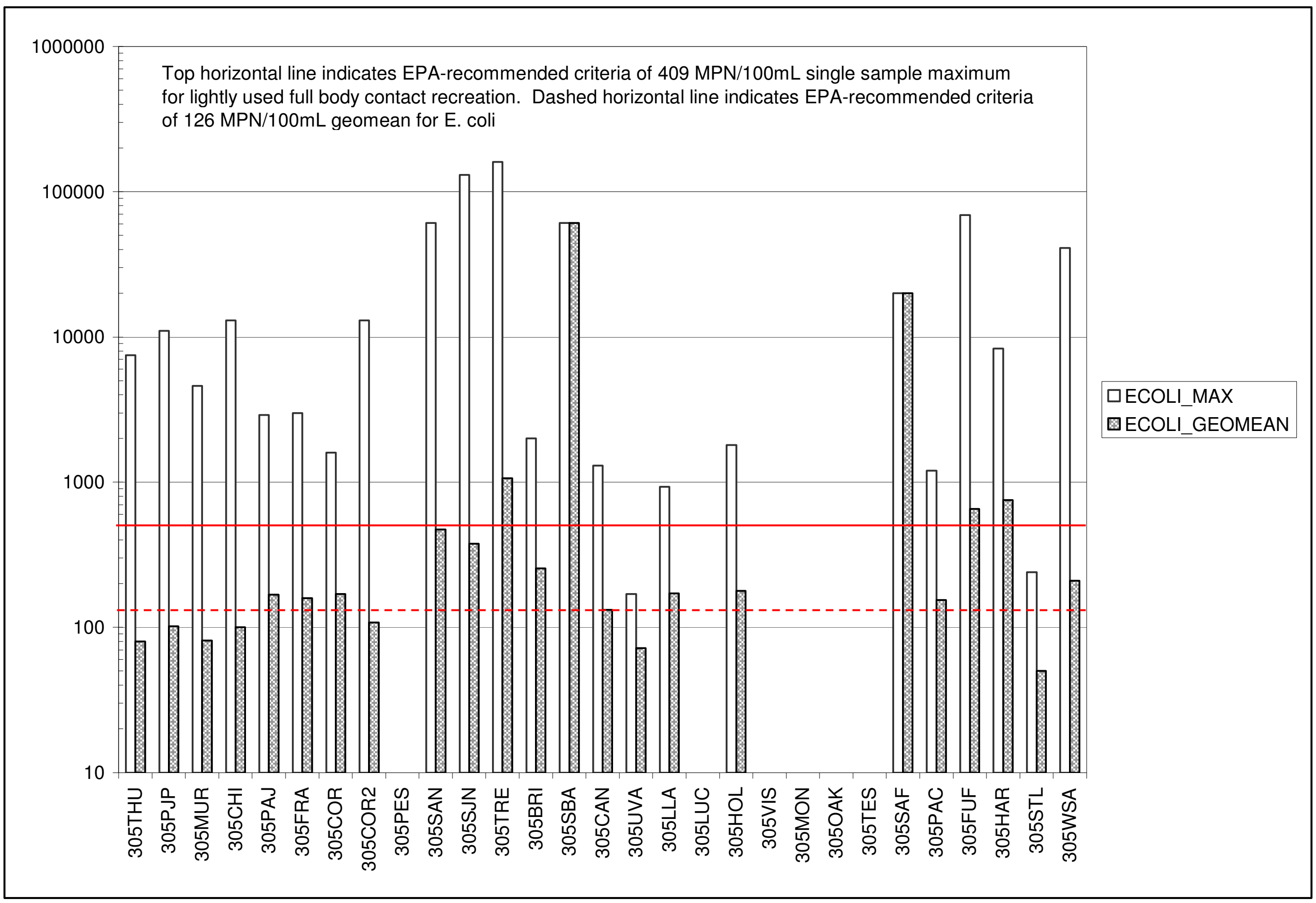

Figure 5. CCAMP maximum and geomean *E. coli* results (1997-1998 and 2005-2006).

Figure 6 shows maximum *E. coli* wet season values (November-April) and maximum dry season (May-October) values. Wet season values are consistently greater for all stations within the Pajaro River study area with the exception of the Furlong Creek at Bloomfied Avenue site (305FUF).

The sites 305TRE, 305SBA, 305UVA, 305HOL and 305SAF did not have more than five samples for either the dry or wet season.

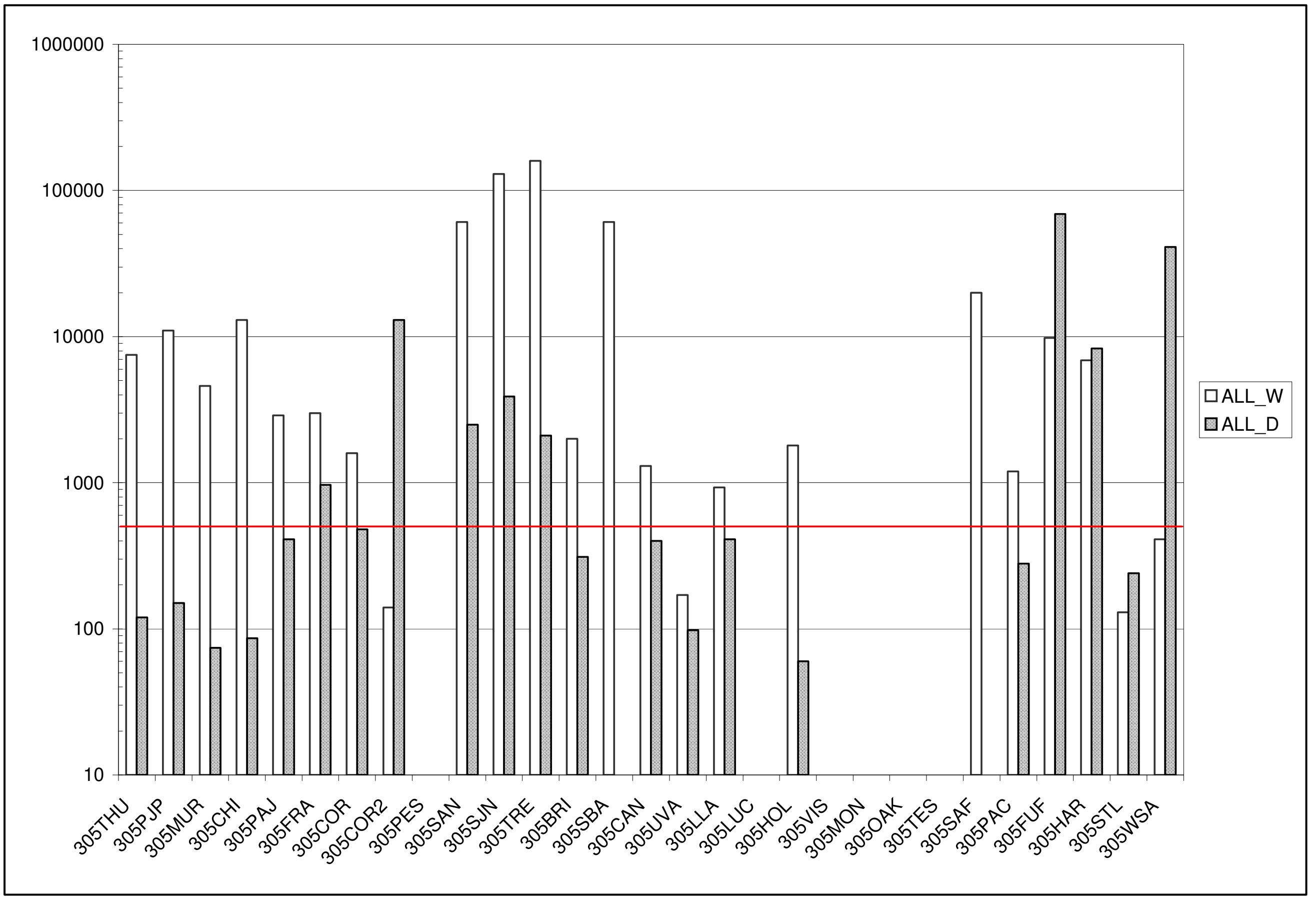

Figure 6. CCAMP maximum *E. coli* values based on wet (Nov–Apr) and dry (May-Oct) seasons (1997-1998 and 2005-2006).

Figure 7 shows CCAMP geomean *E. coli* wet season and dry season values. Geomean *E. coli* values are greater in the wet season for all stations located along lower Pajaro River (305THU through 305PAJ) and dry weather values do not exceed the water quality objective. Other stations exhibiting higher geomean values during the wet season include San Benito River at Y Road (305SAN), San Benito at Bridge (305BRI), and Lower Uvas Creek (305CAN).

Three sites showed higher E. coli geomean values during the dry season. These included Millers Canal and Frazier Lake Road (305FRA), Llagas Creek at Bloomfield Avenue (305LLA), Pachecho Creek (305PAC), and Furlong Creek at Fallon Road (305FUF).

The sites 305TRE, 305SBA, 305UVA, 305HOL and 305SAF did not have more than five samples for either the dry or wet season so a seasonal evaluation of water quality objectives is not relevant.

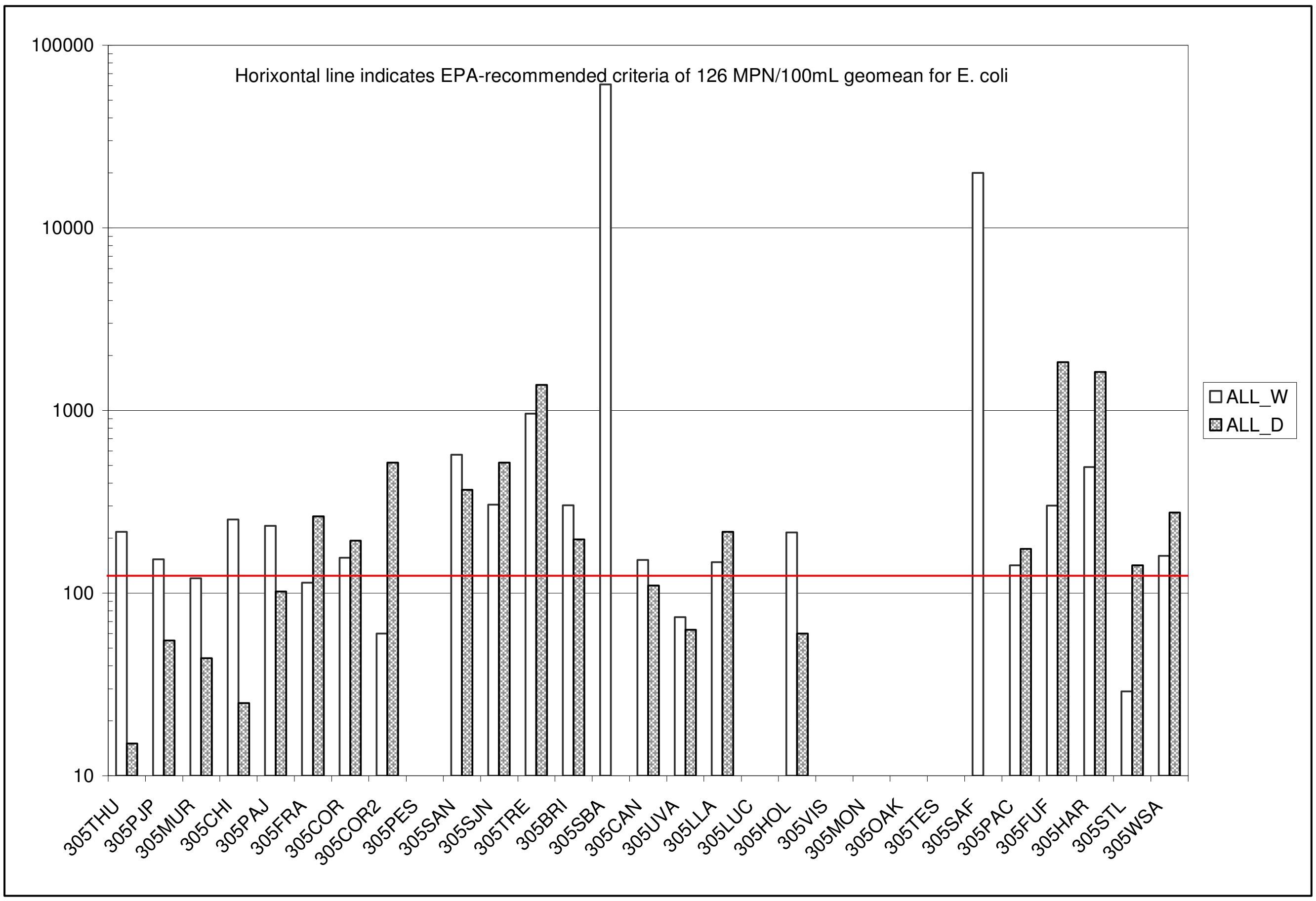

Figure 7. CCAMP geomean *E. coli* values based on wet (Nov–Apr) and dry (May-Oct) seasons (1997-1998 and 2005-2006).

Staff performed additional data analysis to determine if recent 2005-2006 data suggest an improvement or degradation in water quality conditions since the 1997-1998 CCAMP monitoring period. It is important to note that this comparison only includes fecal coliform values because *E. coli* sampling was not conducted during the 1997-1998 sampling period and that many locations do not have values for comparison. Figures 8 and 9 below compare maximum and geomean fecal coliform values for the two monitoring periods, respectively. As shown in Figure 4-8, where two values are available for comparison, maximum values are generally greater in the more recent 2005-2006 sampling round indicating that conditions worsened over the seven year period. Some improvement was observed over this period for 305THU, 305PAJ, 305UVA, 305LLA, 305HOL, and 305PAC.

For sites with both monitoring periods represented in Figure 4-9, the minimum of five samples per period was available for each site, allowing a comparison with water quality objectives.

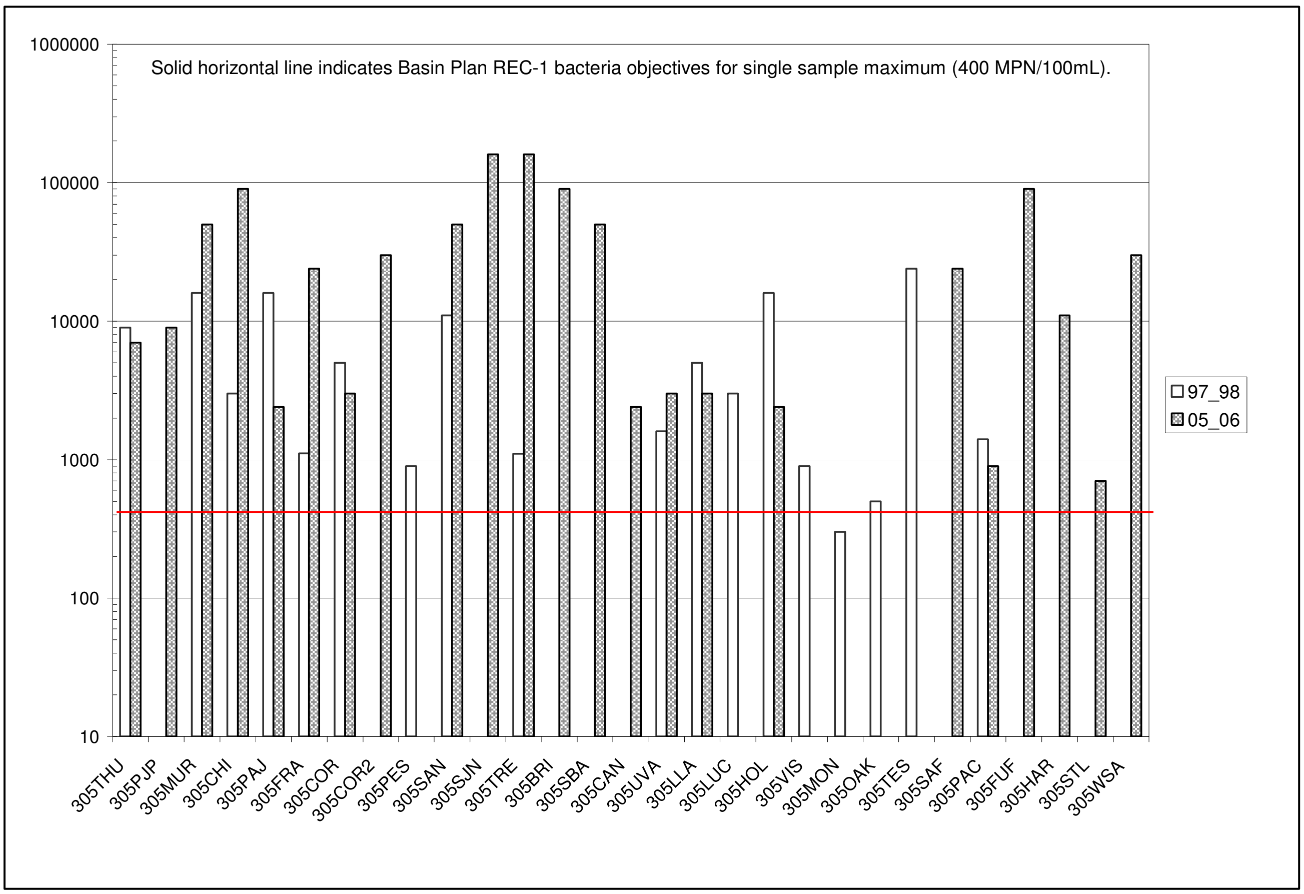

Figure 8. Comparison of CCAMP maximum fecal coliform values between the two sampling events (1997-1998 and 2005-2006).

As shown in Figure 9, where two values are available for comparison, geomean values are generally greater for the 1997-1998 sampling round, indicating an improvement over the seven year period. Monitoring sites 305SAN, 305TRE, and 305PAC showed an increase in geomean values over the same seven year period.

For sites with both monitoring periods represented in Figure 9, the minimum of five samples per period was available for each site which allows for comparison with water quality objectives.

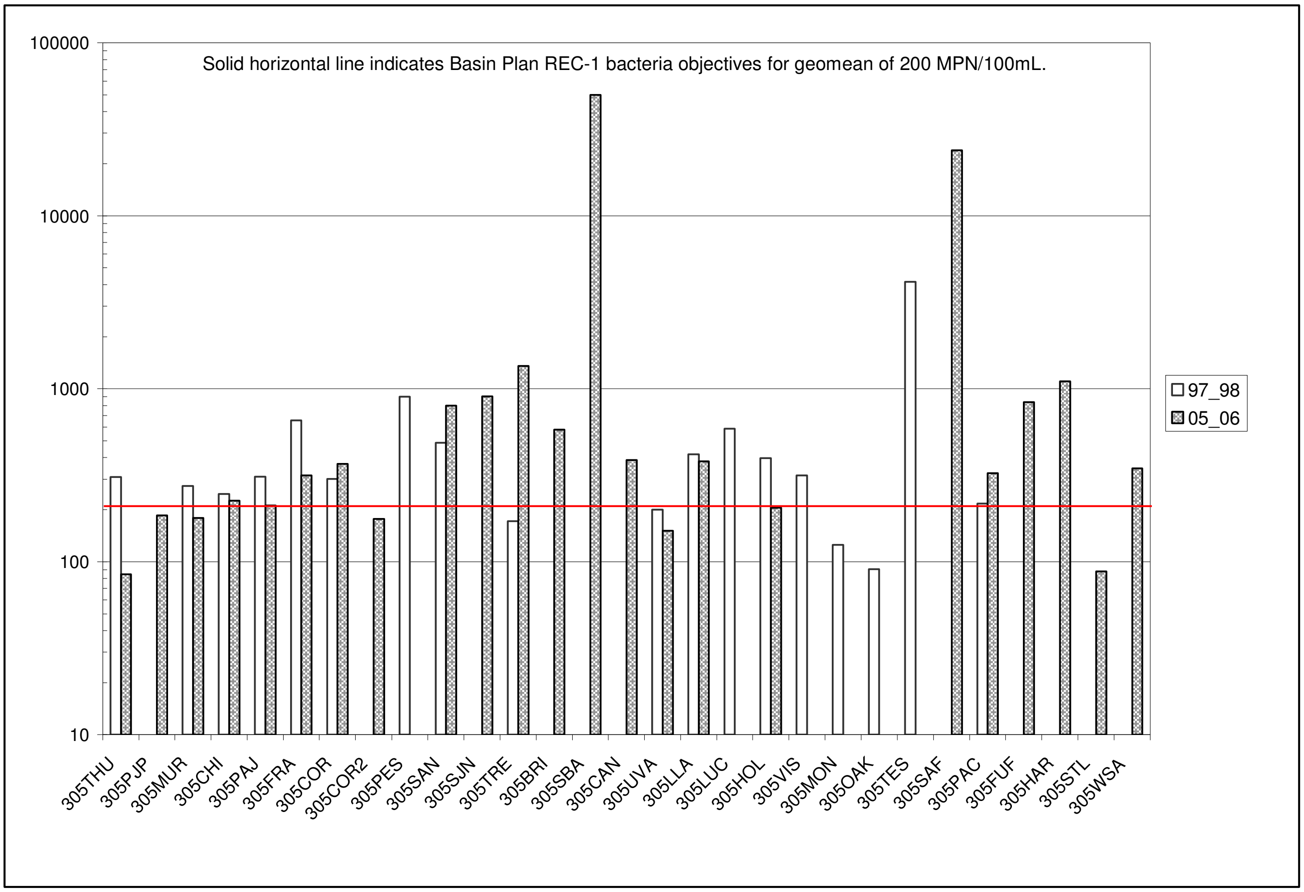

Figure 9. Comparison of CCAMP geomean fecal coliform values between the two sampling events (1997-1998 and 2005-2006).

1.4.1 Summary of CCAMP Data

Staff evaluated 543 data points that were obtained during two CCAMP monitoring rounds of the Pajaro River watershed, from 1997 through 1998 and from 2005 through 2006. The following is a summary of the CCAMP data.

- Fecal coliform maximum values exceed water quality objectives at all stations except for the upper portion of Llagas Creek (305MON). The highest maximum values are found at San Juan Creek (305SJN) which is tributary to Pajaro River and at Tres Pinos Creek (305TRE), a tributary to San Benito River.
- Fecal coliform geomean values exceed water quality objectives at all stations except for Pajaro River at Main Street (305PJP), Uvas Creek (305UVA), and the two stations of upper Llagas Creek (305OAK and 305MON). The highest geomean value was observed at San Juan Creek (305SJN), which is tributary to Pajaro River.
- Wet season fecal coliform maximum values are generally greater than dry season for all stations with the exception of stations located along Uvas Creek (305CAN and 305UVA), lower Llagas Creek (305LLA through 305HOL and 305FUF), upper Llagas Creek (305OAK) and the Pachecho Creek station (305PES). The sampling station on upper Llagas Creek (305MON) met water quality objectives for both seasons.
- Wet season fecal coliform geomean values are greater than the dry season for the five stations located along lower Pajaro River (305THU through 305PAJ) and dry weather values for these stations do not exceed the water quality objective. For the remaining stations in the watershed, fecal coliform geomean values are generally higher during the dry season.
- Two sites of upper Llagas Creek (305MON and 305OAK) attained fecal coliform water quality objectives during both wet and dry seasons.
- Maximum *E. coli* values exceeded the water quality objective at all sites maximum except Uvas Creek (305UVA).
- *E. coli* geomean values are generally exceeded at all monitoring sites with the exception of the lower Pajaro River sites (305THU, 305PJP, 305MUR) and Uvas Creek sites (305CAN and 305UVA).
- Maximum *E. coli* values are greater in the wet season for all stations within the Pajaro River study area with the exception of the Furlong Creek at Bloomfied Avenue site (305FUF).
- Geomean *E. coli* values are greater in the wet season for all stations located along lower Pajaro River (305THU through 305PAJ) and dry weather values for lower Pajaro River stations do not exceed the water quality objective.
- When comparing 1997-1998 and 2005-2006 maximum fecal coliform data, values were generally greater in the more recent 2005-2006 sampling round indicating that conditions worsened over the seven year period. Some improvement was observed over this period for 305THU, 305PAJ, 305UVA, 305LLA, 305HOL, and 305PAC.

- When comparing 1997-1998 and 2005-2006 fecal coliform geomean values, values are generally lower for the 2005-2006, indicating an improvement over the seven year period. Monitoring sites 305SAN, 305TRE, and 305PAC showed an increase in geomean values over the same seven year period.
- *E. coli* data was insufficient to compare between the 1997-1998 and 2005-2006 sampling rounds.

1.5 Water Board Monitoring

Water Board staff designed and implemented a plan for sampling and analyzing additional water column grab samples using the Colilert method, a screening tool that provides results for total coliform and *E. coli*. The goal of Water Board monitoring was to better characterize sources of fecal coliform in the Pajaro River, San Benito River, Llagas Creek, and Tequisquita Slough watersheds. The objectives of monitoring were as follows:

1) to evaluate relative contributions upstream and downstream of sources, such as urban areas (Hollister, San Juan Bautista, Gilroy, and Watsonville), irrigated agriculture, and grazing lands;
2) to determine concentrations in unimpaired waterbodies and gain information on background or reference conditions.

Staff completed five rounds of sampling that collected samples every two weeks from November 30, 2006 to January 25, 2007. A total of 27 sites were selected for the monitoring, however, three of the sites (ALL, ALD, and WIL) were dry during the period and not sampled. Many of the remaining 24 sites are the same as existing CCAMP sites because they can be easily accessed. However, a few additional (non-CCAMP) sites are added to this monitoring plan to provide information that will be helpful in developing the TMDL source analysis. These additional sites are a storm drain on Pajaro River near Main Street (PJPSD), San Juan Creek above San Juan Bautista (SJB), Bird Creek near Hollister Hills (BCC), Pescadero Creek (PSB), and a storm drain near Santa Ana Creek at Fallon Road (SAFSD). The monitoring sites are listed in Table 3, and depicted in Figure 10. Water quality data from this monitoring effort is contained in Attachment 2 and discussed in the following section.

Table 3. Water Board Monitoring sites.

Site ID	Site Description
THU	THU - Pajaro River @ Thurwachter Bridge
PJP	PJP - Pajaro River @ Main Street
PJPSD	PJPSD - Pajaro River @ Main Street Storm Drain
MUR	MUR - Pajaro River @ Murphy's Crossing
CHI	CHI - Pajaro River @ Chittenden Gap
PAJ	PAJ - Pajaro River @ Betabel Road
FRA	FRA - Miller's Canal @ Frazier Lake Road
SAN	SAN - San Benito @ Y Road
SJN	SJN - San Juan Creek @ Anzar
SJB	SJB - San Juan Creek above San Juan Bautista
TRE	TRE - Tres Pinos Creek
BCC	BCC - Bird Creek at Cienega Rd
PSB	PSB - Pescadero Creek tributary to San Benito
BRI	BRI - San Benito River, Bridge d/s Willow Creek
SBA	SBA - San Benito River above unknown tributary
HRL	HRL - San Benito River below Hernandez Reservoir
UVA	UVA - Uvas Creek @ Bloomfield Ave
LLA	LLA - Llagas Creek @ Bloomfield Ave
MON	MON - Llagas Creek @ Monterey Road
TES	TES - Tequisquita Slough
SAF	SAF - Santa Ana Creek @ Fallon Road
SAFSD	SAFSD - Santa Ana Creek @ Fallon Road Storm Drain
PAC	PAC - Pacheco Creek @ San Felipe Road
FUF	FUF - Furlong Creek @ Fraiser Lake Road
ALL	ALL - Alamias Creek at Dunlap Ave
ALL	ALL - Alamias Creek at Leavesley Rd
WIL	WIL - Willow Creek

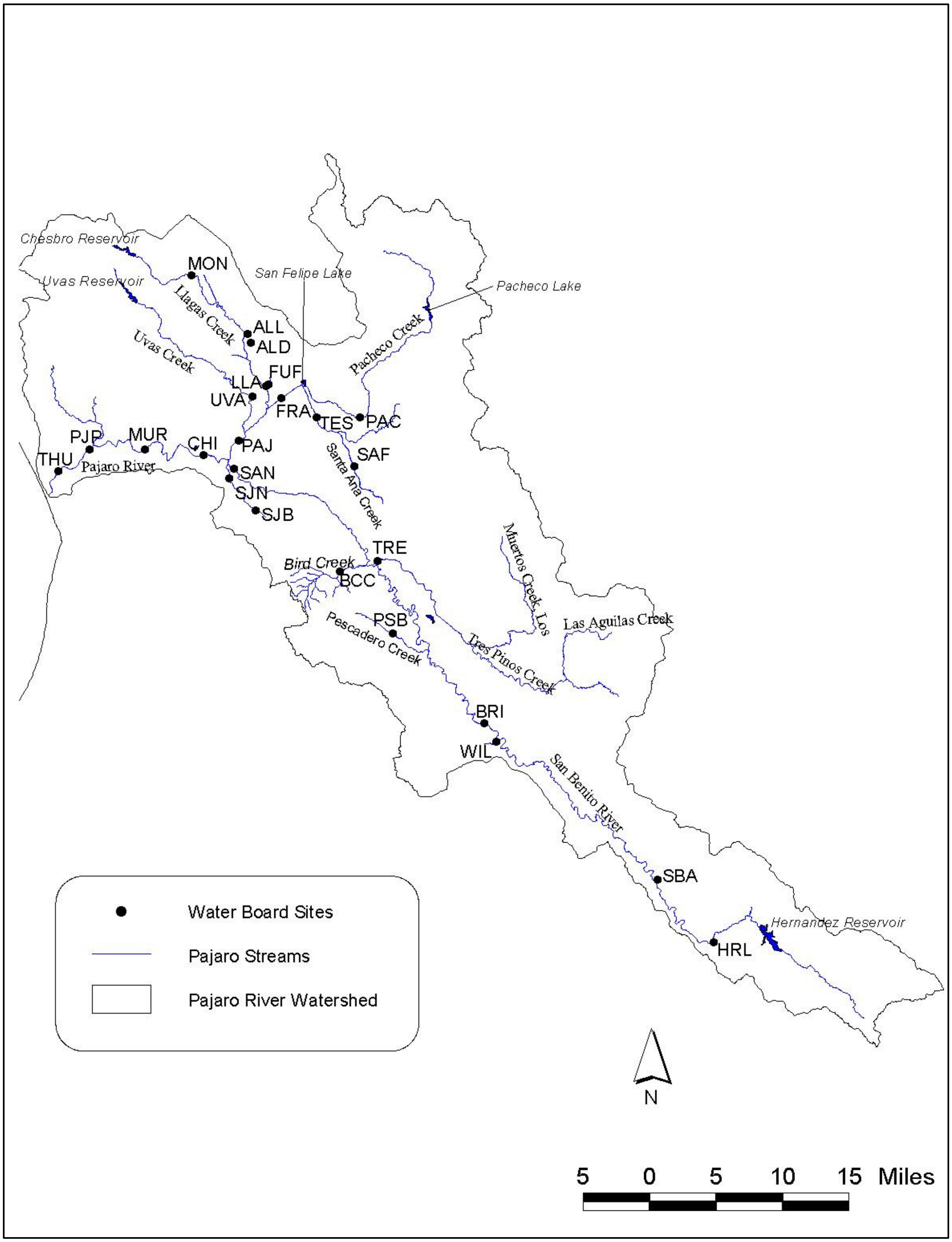

Figure 10. Water Board sampling sites.

Note: Storm drain monitoring locations PJPSD and SAFSD are not depicted; however, these two sites are immediately adjacent to monitoring sites PJP and SAF, respectively.

Water quality data from this monitoring event was compared to U.S. EPA criteria for both single-sample maximum and geomean concentrations for *E. coli*. Please note that total coliform data obtained from this sampling is not comparable to either Basin Plan objectives or EPA-recommended criteria as no total coliform objectives or criteria exist for protecting recreational use. Therefore, total coliform data will not be presented.

Figure 11 below shows geomean *E. coli* values for all samples obtained during Water Board sampling. Monitoring locations are on the x-axis with *E. coli* values along the y-axis. The solid horizontal line represents EPA-recommended *E. coli* geomean criteria of 126 MPN/100ml.

Results indicate that 13 of the 23 sites are below the EPA-recommended criteria with the exception of three San Benito River sites (305SAN, 305SJB, 305BCC), Uvas Creek (305UVA), Llagas Creek (305LLA), Tequisquita Slough and tributary streams (305TES, 305SAF, and 305SAFSD), Pachecho Creek and Furlong Creek (305PAC and 305FUF).

All stations located along lower Pajaro River (305THU through 305PAJ) met water quality objectives. Note that five samples were obtained for all locations with the exception of Llagas Creek (305LLA), where only four samples were obtained.

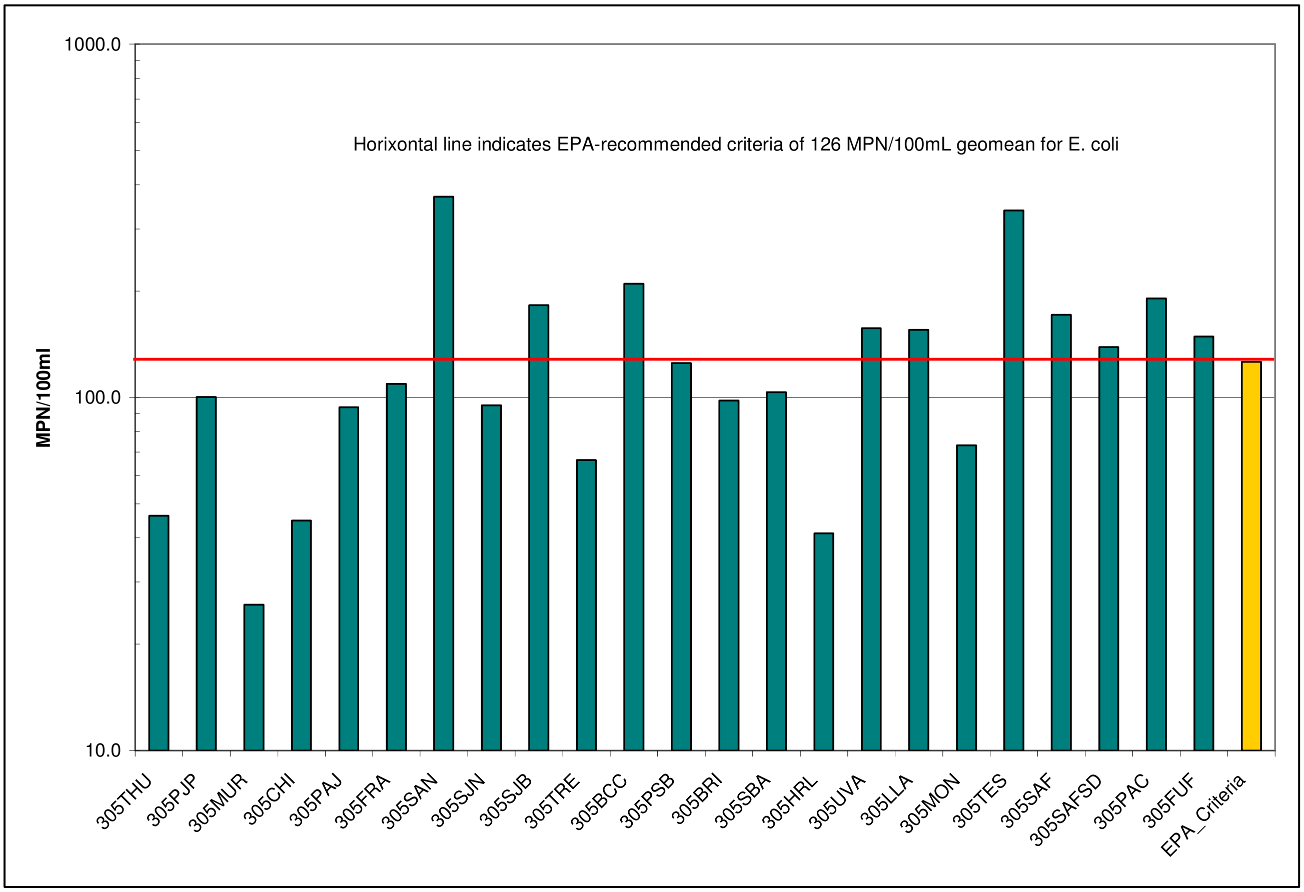

Figure 11. Pajaro River watershed *E. coli* geomean (Nov. 2006 – Jan. 2007)

Figure 12 (next page) shows maximum *E. coli* values. The solid horizontal line represents the EPA-recommended single sample maximum for *E. coli* of 409 MPN/100ml.

Results indicate that 16 of the 24 sites are below the EPA-recommended criteria with the exception of the two storm drains sites (305PJPSD and 305SAFSD), three San Benito River sites (305SAN, 305SJB, 305BCC), and the Tequisquita Slough and a tributary stream (305TES and 305SAF).

Note that only one sample was obtained from 305PJPSD and four samples for 305LLA, therefore the minimum sample count of five was not obtained for these sites. All other sites had a minimum of five samples.

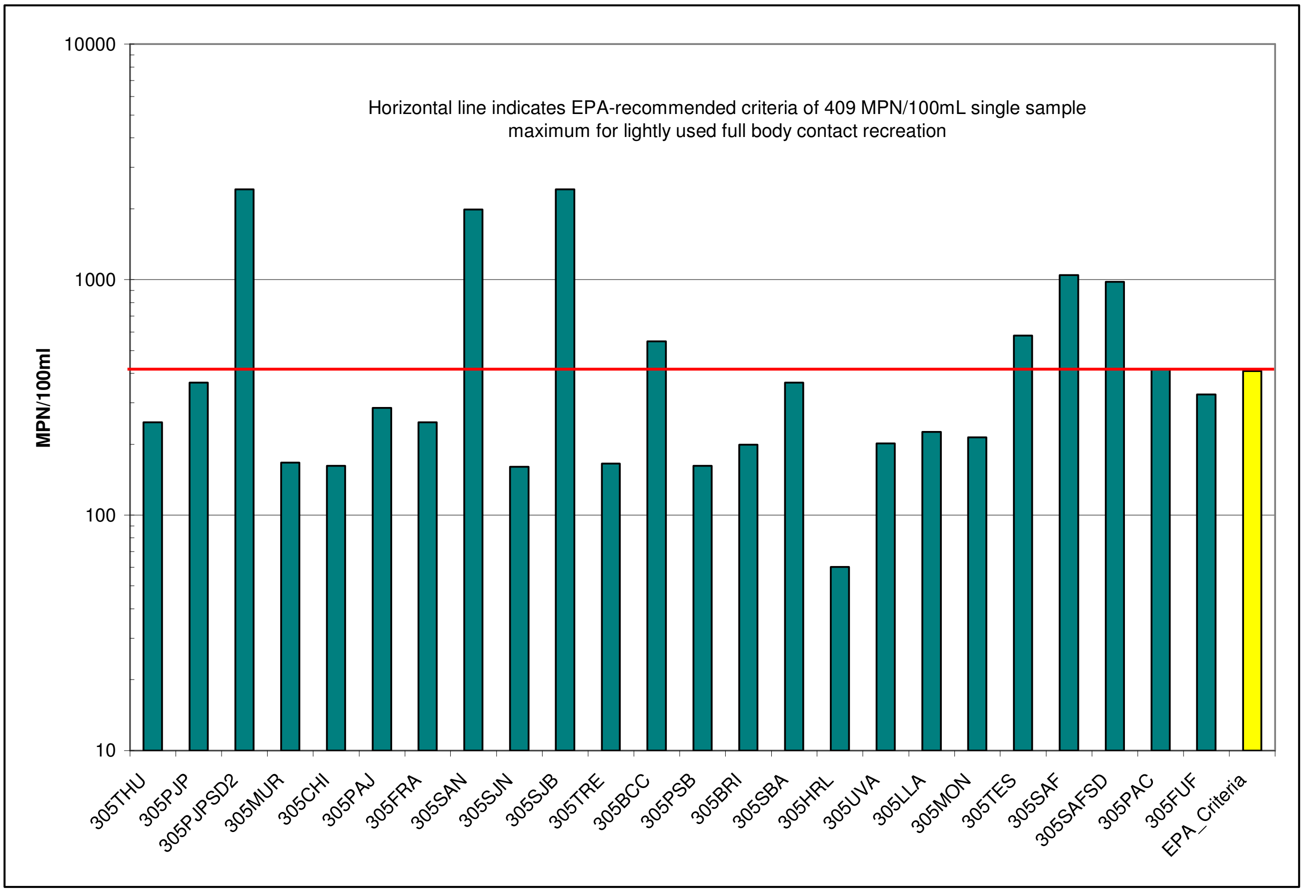

Figure 12. Pajaro River watershed *E. coli* maximum values (Nov. 2006 – Jan. 2007).

1.5.1 Summary of Water Board Monitoring

Water Board staff evaluated 94 data points from 24 sites within the Pajaro River watershed. Samples were obtained from November 2006 to January 2007 and tested for total coliform and *E. coli*. There are no total coliform water quality objectives that protect recreational use; therefore only *E. coli* results are presented in this section.

- Thirteen (13) sites are below the EPA-recommended single sample maximum criteria for *E. coli* of 409 MPN/100ml. Sites exceeding this criteria are three San Benito River sites (305SAN, 305SJB, 305BCC), Uvas Creek (305UVA), Llagas Creek (305LLA), Tequisquita Slough and tributary streams (305TES, 305SAF, and 305SAFSD), Pachecho Creek and Furlong Creek (305PAC and 305FUF).
- Sixteen (16) sites are below the EPA-recommended geomean criteria for *E. coli* of 126 MPN/100ml. Sites exceeding this criteria are two storm drains (305PJPSD and 305SAFSD), two San Benito River sites (305SAN,

305SJB, 305BCC), and Tequisquita Slough and tributary streams (305TES and 305SAF).

- The highest *E. coli* concentration was observed to be greater than the maximum quantification limit of 2419.6 MPN/100ml. This location was the storm drain located on the Pajaro River at Main Street (305PJPSD). The sample was obtained during a rain event on December 12, 2006 and verified with a duplicate sample.
- All stations located in lower Pajaro River (305THU through 305MUR) were below EPA-recommended criteria for *E. coli,* both single sample maximum and geomean. The site located on Pajaro River at Murphy's Crossing had the lowest geomean value of 26 MPN/100ml.
- The site with the lowest single sample maximum value was San Benito River downstream from Hernandez Reservoir (305HRU).
- EPA-recommended criteria for both single sample maximum and geomean *E. coli* were exceeded at three San Benito River sites (305SAN, 305SJB, 305BCC), and three Tequisquita Slough sites (305TES, 305SAF, and 305SAFSD).

1.6 *E. Coli* O157:H7 Investigation

On September 13, 2006, the Centers for Disease Control and Prevention (CDC) alerted the U.S. Food and Drug Administration (FDA) of a multi-state *E. coli* outbreak that appeared to be associated with consumption of bagged spinach. The FDA and California Department of Health Services, Food and Drug Branch (CDHS) jointly formed the California Food Emergency Response Team (CalFERT) and investigated potential *E. coli* O157:H7 sources within the central coast region. CalFERT found *E. coli* O157:H7 in several environmental samples (water, soil, animal feces), however the investigation eventually focused on a San Benito county ranch located in Paicines. CalFERT investigators used pulsed field gel electrophoresis (PFGE) to identify the *E. coli* O157:H7 pattern and determine if this pattern was consistent with the outbreak strain of *E. coli* O157:H7. PFGE is a method for separating large DNA molecules, which may be used for genotyping or genetic fingerprinting. CalFERT investigators found that the PFGE patterns of some samples were indistinguishable from the *E. coli* O157:H7 outbreak strain found in the bagged spinach. The PFGE pattern was identified in San Benito River water, cattle feces, wild pig feces, and soil on the ranch. Land on the ranch was primarily utilized for cattle grazing with a small amount of land used for crop production. Investigators observed evidence of wild pig in and around the cattle pastures as well as in the row crop areas of the ranch. Investigators established that numerous wild pigs thrived alongside grazing cattle in the riparian habitat of the ranch.

The investigation found that groundwater levels rose above and fell below San Benito riverbed levels, potentially allowing surface water from the river flowing into the ranch valley to percolate into the ground again and recharge groundwater; however, further assessments will be needed to determine this likelihood. The investigation concluded that no definitive determination could be made regarding how *E. coli* O157:H7 pathogens contaminated spinach in the outbreak (CalFERT, 2007).

1.7 Land Use

Water Board staff used spatial data to define subbasins and drainage areas, compile land use tables; represent hydrologic networks, and prepare maps. Land use activities within subbasin areas help describe the condition of the watershed and interpret the relative effects of land use activities on indicator bacteria levels. Water Board staff used USGS 30-meter Digital Elevation Models to determine subbasin boundaries within the greater Pajaro River watershed as indicated in Figure 13. Twenty-two (22) subbasins were delineated to highlight land use activities within drainage areas for the monitoring sites. Staff then used Farmland Mapping and Monitoring Program (FMMP) data from the California Department of Conservation, Division of Land Resource Protection to classify land use. The FMMP land use categories include prime irrigated agricultural, irrigated agricultural of state significance, orchards and vineyards, dry cropland, grazing land, urban developed land, "other" lands (e.g., forested, government-owned, rural residential), and water. Attachment 3 contains the FMMP land use descriptions and Table 4 displays land use acres and percent coverage for the 22 subwatersheds.

Grazing is the predominant land use within the Pajaro River watershed with an area of 62%, followed by the "other" land use category (e.g., forested, government-owned, rural residential) at 21% , irrigated agricultural lands (10%), urban 3%, and dry land farming 3%.

Using Water Board Monitoring data, staff evaluated the potential impact of land use activities upon *E. coli* water quality conditions within the watershed and concluded that a direct relationship does not exist.

For example, subbasins dominated by grazing land use areas with little agricultural use may or may not meet the EPA-recommended geomean criteria for *E. coli*, as evidenced in a comparison between subbasins BRI_22 with 85% grazing and an *E. coli* geomean of 98 MPN/100ml and PAC_9 with 75% grazing and 191 MPN/100ml. In addition, subbasin TRE_2 has the largest percent area of grazing lands (91%), however the *E. coli* geomean value is 66 MPN/100ml which is below the EPA-recommended level of 126 MPN/100ml.

In a similar fashion, the percentage of irrigated agricultural activities land does not aide in the prediction of water quality conditions. For example, monitoring stations for subbasins TES_8 (22% agriculture) and SJB_16 (27% agriculture) have relatively high *E. coli* geomean values of 338 and 182 MPN/100 ml, respectively. While subbasins with a greater percentage of irrigated agriculture, FRA_7 (34%) and PAJ_5 (35%) had *E. coli* geomean values of 109 and 94

MPN/100 ml, respectively, and each are below the EPA-recommended level of 126 MPN/100ml.

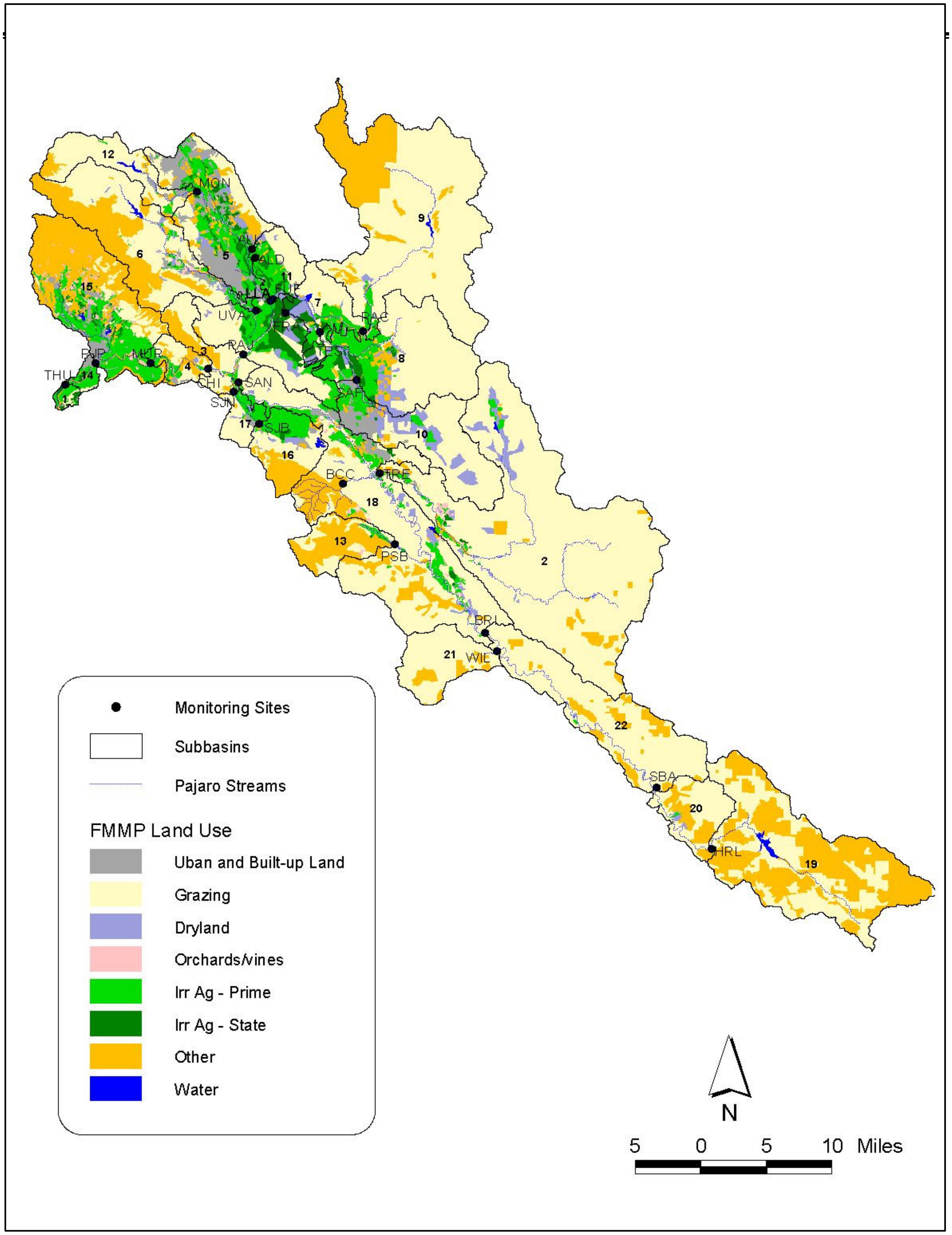

Figure 13. Subwatersheds, land use, and monitoring sites.

Table 4. Land uses and subbasins within the Pajaro River watershed.

Sub-basin		Pajaro River Land Use Description								
		Dry land	Grazing	Irr Ag-Prime	Irr Ag-State	Orch Vine	Other	Urban	Water	Total
HRL_19	mi^2		48.5				63.4		1.0	112.9
	%		42.9				56.2		0.9	
SBA_20	mi^2	0.4	16.8	0.1	0.0	0.0	6.7			24.0
	%	1.6	70.0	0.5	0.1	0.1	27.8			
BRI_22	mi^2	0.3	60.0	0.1			9.7			70.0
	%	0.4	85.6	0.1			13.9			
SAN_18	mi^2	3.5	89.8	9.6	0.7	1.5	22.5	3.1	0.1	130.7
	%	2.6	68.7	7.3	0.5	1.2	17.2	2.4	0.1	
WIL_21	mi^2		23.8				3.8			27.6
	%		86.1				13.9			
PSB_13	mi^2	0.0	6.8	0.8	0.1	0.2	14.0			21.9
	%	0.2	31.0	3.4	0.3	1.1	63.9			
TRE_2	mi^2	5.8	196.7	2.7	0.4	1.2	7.6	0.3	0.2	214.9
	%	2.7	91.5	1.3	0.2	0.5	3.5	0.2	0.1	
SAF_10	mi^2	7.8	31.4	4.5	0.4	0.2	1.3	5.4		50.9
	%	15.3	61.6	8.9	0.8	0.3	2.6	10.5		
TES_8	mi^2	5.4	45.1	12.1	3.8	0.4	3.6	0.4		70.8
	%	7.7	63.7	17.1	5.4	0.5	5.1	0.6		
SJB_16	mi^2	0.8	8.5	6.2	0.5	0.0	7.7	0.8	0.3	24.8
	%	3.2	34.3	25.0	1.8	0.1	31.2	3.1	1.4	
SJN_17	mi^2	0.3	5.8	2.5	0.1		0.2	0.5		9.5
	%	3.1	61.6	26.6	1.3		2.0	5.3		
PAC_9	mi^2	0.5	110.9	2.1	0.1	0.2	32.8	0.1	0.3	146.9
	%	0.3	75.5	1.4	0.1	0.1	22.3	0.1	0.2	
FRA_7	mi^2	1.9	10.8	4.8	2.4	0.1	0.8	0.2	0.2	21.0
	%	8.9	51.2	22.6	11.4	0.5	3.6	1.0	0.8	
FUF_11	mi^2	0.7	7.3	5.6	1.9	0.3	0.4	0.4		16.5
	%	4.2	44.4	33.9	11.5	1.6	2.2	2.3		
MON_12	mi^2	0.1	20.5	0.8	0.1	0.1	3.3	1.3	0.4	26.6
	%	0.2	77.2	3.0	0.3	0.3	12.6	5.0	1.4	
PAJ_5	mi^2	4.8	32.4	23.0	12.2	0.8	8.5	17.4		99.1
	%	4.9	32.7	23.2	12.3	0.8	8.6	17.6		
UVA_6	mi^2	1.1	36.0	2.5	0.1	1.0	29.0	2.6	0.4	72.8
	%	1.6	49.5	3.4	0.2	1.4	39.8	3.6	0.5	
CHI_3	mi^2	0.0	12.6	0.7	0.0	0.0	6.0	0.4		19.7
	%	0.0	64.0	3.4	0.2	0.1	30.4	2.0		
MUR_4	mi^2	0.1	5.1	2.1	0.1	0.2	3.4	0.4	0.3	11.7
	%	1.2	43.3	18.3	0.6	1.9	28.9	3.5	2.4	
PJP_15	mi^2	0.0	6.8	18.5	2.2	4.0	36.9	5.2	0.3	73.8
	%	0.0	9.2	25.1	2.9	5.5	49.9	7.0	0.4	
THU_14	mi^2		0.2	2.2	0.3	0.1	0.3	0.8		4.0
	%		6.2	56.4	8.7	1.5	6.3	21.0		
_1	mi^2		0.5	1.3	0.8	0.1	0.2	0.1		2.9
	%		16.2	44.4	25.9	3.8	7.9	1.8		
Total	mi^2	33.4	776.1	102.0	26.1	10.4	262.0	39.4	3.3	1252.9
	%	2.7	61.9	8.1	2.1	0.8	20.9	3.1	0.3	

1.8 Relationship of Genetic Studies to Land Use in Other Watersheds

Genetic ribotyping is a microbiological source tracking method that differentiates animal *E. coli* from other sources of animal *E. coli*. This tracking method identifies the animals from which *E. coli* originate and an estimate of relative contribution; however it does not provide the geographic locations or land uses where the animals reside or how the *E. coli* was transported from the animal to the waterbody. Staff considered ribotyping results as an estimate of possible sources and of relative source contributions among all of the various sources. Ribotyping represents one of the "lines of evidence" in determining source contribution.

Water Board staff evaluated results of genetic studies conducted in other Central Coast Region watersheds to assist in characterizing sources of indicator bacteria in the Pajaro River Watershed. The discussion below includes an analysis of land use influence on fecal coliform concentrations in two watersheds with similar land uses: the Watsonville Slough Watershed and the Morro Bay Watershed.

A study conducted in the Watsonville Slough Watershed (Hager et al, 2005) determined that all land uses were associated with exceedances of water quality objectives. Staff examined the association of dominant land use in subwatersheds of the Watsonville Sough Watershed where water quality objectives were exceeded. Staff concluded that these exceedances occurred in summer and/or winter regardless of dominant land uses (see Table 5 next page).

Staff found a consistent depression of the bird component of indicator bacteria with wet conditions. This pattern was also found in the Morro Bay Watershed. Data suggested that winter runoff introduced additional fecal coliform from non-bird sources, reducing the proportion of bird indicator bacteria from 98 to 38 percent in one subwatershed of the Watsonville Slough. While the findings in Table 5 confirmed contributions from terrestrial sources, they did not definitively indicate which land use contributed which terrestrial source. Stated another way, terrestrial sources (dog, cow, human) were not well correlated with a specific land use.

The data from the Watsonville Sloughs also indicated that urban land uses were commonly associated with concentrations of *E. coli* in excess of water quality objectives. Furthermore, the analysis of genetic sources relative to land uses revealed that urban uses were implicated as sources of controllable fecal material from dogs and humans.

Table 5. Land uses surrounding sampling locations for genetic source tracking and results of genetic analysis for wet and dry seasons in Watsonville sloughs, 2003.

Land use (% of subwatershed)		Rabbit		Human		Dog		Bird		Cow	
		Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet
Struve Slough		Percent of Sample									
Urban	45%	0	0	0	3	2	21	98	38	0	38
Commercial	45%										
Agricultural	10%										
Lower Watsonville Slough											
Agricultural	85%	0	0	0	0	6	28	94	20	0	52
Undeveloped	15%										
Upper Harkins Slough											
Undeveloped	65%	0	0	1	2	47	9	52	18	0	71
Grazing	20%										
Rural Residential	10%										
Agricultural	5%										

Source: Hager, et al., 2004, and SH&G, et al., 2003.

A genetic fingerprinting study was conducted in the Morro Bay Watershed (California Polytechnic State University, 2002). Data collected from Chorro and Los Osos Creeks in the Morro Bay Watershed indicated that bovine (cow) sources contributed the majority (31 percent) of E. coli in Chorro Creek, a watershed with 63 percent rangeland. Bovine sources contributed similar levels of E. coli during both wet and dry weather sampling, as did all sources, therefore Table 6 (next page) does not distinguish between wet and dry sources. In Los Osos Creek, a watershed with a mixture of urban, rangeland, and agriculture, no one source exceeded 20 percent of the total. Table 6 describes land uses surrounding sampling locations and results of genetic analyses in Chorro and Los Osos Creeks.

Table 6. Land uses surrounding sampling locations for genetic source tracking and results of genetic analysis in Chorro and Los Osos Creeks, 2002.

<table>
<tr><th colspan="2">Land use
(Percent of subwatershed)</th><th>Avian</th><th>Cow</th><th>Dog</th><th>Human</th></tr>
<tr><td colspan="6">Chorro Creek</td></tr>
<tr><td>Urban</td><td>5.4%</td><td rowspan="5">11</td><td rowspan="5">31</td><td rowspan="5">6</td><td rowspan="5">13</td></tr>
<tr><td>Rangeland</td><td>62.8%</td></tr>
<tr><td>Agricultural</td><td>6.1%</td></tr>
<tr><td>Brushland</td><td>17.0%</td></tr>
<tr><td>Woodland</td><td>8.7%</td></tr>
<tr><td colspan="6">Los Osos Creek</td></tr>
<tr><td>Urban</td><td>16.9%</td><td rowspan="5">20</td><td rowspan="5">8</td><td rowspan="5">12</td><td rowspan="5">19</td></tr>
<tr><td>Rangeland</td><td>37.3%</td></tr>
<tr><td>Agricultural</td><td>18.8%</td></tr>
<tr><td>Brushland</td><td>3.3%</td></tr>
<tr><td>Woodland</td><td>16.8%</td></tr>
</table>

The land uses (grazing, urban, irrigated agriculture, and others) addressed in this project are similar to those in the Watsonville Slough and Morro Bay Watersheds. While it is not possible to definitively determine which sources are originating from each land use because each watershed has multiple land uses, some of the conclusions from these studies can be transferred to the watersheds addressed in this report.

1.9 Data Analysis Summary

Water quality data, land use data, and the results of bacteria indicator studies within other Central Coast watersheds has led staff to conclude that sources of indicator bacteria are widespread both spatially and temporally. Exceedences of the water quality objectives are attributable to all land uses and observed throughout all subwatersheds and seasons. In addition, there is a lack of direct information that leads this analysis to a single source of impairment. Rather, the problem is widespread, and to some extent, consistent across the watershed.

Staff also considered data and information from field observations, interviews with Water Board program staff, Water Board files and reports, and communication with representatives from city, county, and resource agencies (e.g., County Resource Conservation Districts and Farm Bureaus). Details regarding this additional information are contained in Section 5, *Source Analysis*, within the body of the main report.

2 REFERENCES

California Food Emergency Response Team (CalFERT). 2007. *Investigation of an Escherichia coli O157:H7 Outbreak Associated with Dole Pre-Packaged Spinach.* March 21, 2007. Accessed March 23, 2007 at http://www.dhs.ca.gov/ps/fdb/local/PDF/2006%20Spinach%20Report%20Final%20redacted.PDF

California Polytechnic State University, et al. *Identifying the Sources of Escherichia coli Contamination to the Shellfish Growing Areas of the Morro Bay Estuary*. March 15, 2002.

Hager, Julie, Fred Watson, Joanne Le, and Betty Olson. *Watsonville Sloughs Pathogen Problems and Sources.* July 2004.

State Water Resources Control Board. 2004. *Water Quality Control Policy for Developing California's Clean Water Act Section 303(d) List*, adopted September 30, 2004.

State Water Resources Control Board. 2004. *Policy for implementation and Enforcement of the Nonpoint Source Pollution Control Program,* May 20, 2004.

Swanson Hydrology & Geomorphology, Biotic Resources Group, Dana Bland & Associates, Hagar Environmental Sciences, and VB Agricultural Services, 2003. *Watsonville Sloughs Watershed Resource Conservation & Enhancement Plan,* January 2003.

U.S. Environmental Protection Agency. 1986. Ambient Water Quality Criteria for Bacteria – 1986. EPA440/5-84-002.

U.S. Environmental Protection Agency. 2002. Implementation Guidance for Ambient Water Quality Criteria for Bacteria, May 2002 Draft. EPA-823-B-02-003.

Water Quality Control Plan, Central Coast Region. 1994.

ATTACHMENT 1

CCAMP DATA

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLI MAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305BRI	01/24/05	230	160									
305BRI	02/22/05	300	540									
305BRI	03/23/05	90000	2000									
305BRI	04/19/05	500	170									
305BRI	5/17/05	300	310									
305BRI	6/14/05	170	180									
305BRI	7/19/05	300	190									
305BRI	8/17/05	500	270									
305BRI	9/13/05	300	98									
305BRI	10/12/05	800	210									
305BRI	11/9/05	1100	190									
305BRI	12/6/05	800	440									
305BRI	1/10/06	300	280									
305BRI	2/21/06	240	32									
305BRI	3/14/06	800	990									
305BRI				05_06_D	6	310	200	350	6	310	200	197
305BRI				05_06_W	9	90000	500	814	9	2000	280	303
305BRI				05_06	15	90000	300	581	15	2000	210	255
305BRI				ALL_D	6	310	200	350	6	310	200	197
305BRI				ALL_W	9	90000	500	814	9	2000	280	303
305BRI				ALL	15	90000	300	581	15	2000	210	255
305CAN	1/25/05	300	190									
305CAN	2/23/05	170	170									
305CAN	3/24/05	1700	1300									
305CAN	4/20/05	300	170									
305CAN	5/18/05	500	41									
305CAN	5/19/05	230	52									
305CAN	6/15/05	2200	100									
305CAN	7/20/05	240	400									
305CAN	8/18/05	800	310									
305CAN	9/15/05	230	31									
305CAN	10/13/05	2400	240									
305CAN	11/10/05	240	24									
305CAN	12/7/05	110	63									
305CAN	1/11/06	240	120									
305CAN	2/23/06	50	38									
305CAN	3/15/06	900	880									
305CAN				05_06_D	7	2400	500	614	7	400	100	110
305CAN				05_06_W	9	1700	240	285	9	1300	170	152
305CAN				05_06	16	2400	270	387	16	1300	145	132
305CAN				ALL_D	7	2400	500	596	7	400	100	110
305CAN				ALL_W	9	1700	240	269	9	1300	170	152
305CAN				ALL	16	2400	270	381	16	1300	145	132
305CHE	2/10/98	900										
305CHE	3/5/98	130										
305CHE	6/12/98	300										
305CHE	7/20/98	1700										
305CHE	8/11/98	2400										
305CHE	9/10/98	50										
305CHE	10/15/98	14										
305CHE	11/4/98	23										
305CHE	12/2/98	110										
305CHE	1/7/99	30										
305CHI	12/18/97	500										
305CHI	1/19/98	3000										
305CHI	2/10/98	1600										
305CHI	2/19/98	3000										
305CHI	3/5/98	110										
305CHI	3/12/98	500										
305CHI	5/27/98	900										
305CHI	6/12/98	280										
305CHI	6/30/98	80										
305CHI	7/20/98	240										
305CHI	7/31/98	170										
305CHI	8/11/98	140										

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLI MAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305CHI	9/3/98	300										
305CHI	9/10/98	80										
305CHI	9/30/98	240										
305CHI	10/15/98	170										
305CHI	10/21/98	170										
305CHI	11/4/98	170										
305CHI	11/10/98	300										
305CHI	12/2/98	500										
305CHI	12/16/98	170										
305CHI	1/7/99	130										
305CHI	1/24/05	50	41									
305CHI	2/22/05	500	340									
305CHI	3/23/05	90000	13000									
305CHI	4/19/05	50	110									
305CHI	5/17/05	50	10									
305CHI	6/14/05	130	86									
305CHI	7/19/05	30	20									
305CHI	8/17/05	80	10									
305CHI	9/13/05	240	31									
305CHI	10/12/05	80	41									
305CHI	11/9/05	110	41									
305CHI	12/6/05	50	120									
305CHI	1/10/06	700	190									
305CHI	2/21/06	500	52									
305CHI	3/14/06	3000	4400									
305CHI				97_98_D	16	2400	205	212				
305CHI				97_98_W	16	3000	235	286				
305CHI				97_98	32	3000	205	246				
305CHI				05_06_D	6	240	80	82	6	86	26	25
305CHI				05_06_W	9	90000	500	442	9	13000	120	253
305CHI				05_06	15	90000	110	225	15	13000	52	100
305CHI				ALL_D	22	2400	170	173	6	86	26	25
305CHI				ALL_W	25	90000	300	334	9	13000	120	253
305CHI				ALL	47	90000	170	239	15	13000	52	100
305COR	12/18/97	5000										
305COR	1/19/98	900										
305COR	2/19/98	3000										
305COR	3/12/98	80										
305COR	5/27/98	80										
305COR	6/30/98	70										
305COR	7/31/98	300										
305COR	9/3/98	240										
305COR	9/30/98	2400										
305COR	10/21/98	110										
305COR	11/10/98	70										
305COR	12/16/98	70										
305COR	1/24/05	2400	10									
305COR	2/22/05	300	380									
305COR	3/23/05	2400	730									
305COR	4/19/05	30	41									
305COR	5/17/05	80	31									
305COR	6/14/05	220	120									
305COR	7/19/05	240	480									
305COR	8/17/05	300	360									
305COR	9/13/05	500	360									
305COR	10/12/05	110	230									
305COR	11/9/05	300	320									
305COR	12/6/05	500	210									
305COR	1/10/06	2300	130									
305COR	2/21/06	80	35									
305COR	3/14/06	3000	1600									
305COR				97_98_D	6	2400	175	218				
305COR				97_98_W	6	5000	490	417				
305COR				97_98	12	5000	175	301				
305COR				05_06_D	6	500	230	203	6	10	8	194

305COR				05_06_W	9	3000	500	546	9	3000	500	156
305COR				05_06	15	3000	300	367	15	1600	230	170
305COR				ALL_D	12	2400	230	210	6	480	295	194
305COR				ALL_W	15	5000	500	490	9	1600	210	156
305COR				ALL	27	5000	300	336	15	1600	230	170
305COR2	1/24/05	30	41									
305COR2	2/22/05	80	41									
305COR2	3/23/05	240	140									
305COR2	4/21/05	30	31									
305COR2	5/19/05	30000	13000									
305COR2	6/16/05	500	170									
305COR2	7/21/05	130	63									
305COR2	12/8/05	80	110									
305COR2	1/12/06	50	41									
305COR2	2/23/06	130	90									
305COR2	3/16/06	300	54									
305COR2				05_06_D	3	30000	500	1249	3	13000	170	518
305COR2				05_06_W	8	140	48	85	8	140	48	60
305COR2				05_06	11	30000	130	177	11	13000	63	108
305COR2				ALL_D	3	30000	500	1249	3	13000	170	518
305COR2				ALL_W	8	140	48	85	8	140	48	60
305COR2				ALL	11	30000	130	177	11	13000	63	108
305FRA	2/10/98	1110										
305FRA	3/5/98	800										
305FRA	6/12/98	500										
305FRA	7/20/98	900										
305FRA	8/11/98	1100										
305FRA	9/10/98	900										
305FRA	10/15/98	900										
305FRA	11/4/98	500										
305FRA	12/2/98	500										
305FRA	1/7/99	170										
305FRA	1/25/05	30	52									
305FRA	2/23/05	50	86									
305FRA	3/24/05	24000	3000									
305FRA	4/20/05	50	35									
305FRA	5/18/05	300	250									
305FRA	6/15/05	800	280									
305FRA	7/20/05	1300	970									
305FRA	8/18/05	500	300									
305FRA	9/15/05	300	260									
305FRA	10/13/05	300	63									
305FRA	11/10/05	300	74									
305FRA	12/7/05	130	74									
305FRA	1/11/06	800	220									
305FRA	2/22/06	50	10									
305FRA	3/15/06	800	570									
305FRA				97_98_D	5	1100	900	833				
305FRA				97_98_W	5	1110	500	519				
305FRA				97_98	10	1110	850	658				
305FRA				05_06_D	6	1300	400	491	6	970	270	263
305FRA				05_06_W	9	24000	130	236	9	3000	74	114
305FRA				05_06	15	24000	300	316	15	3000	220	159
305FRA				ALL_D	11	1300	800	624	6	970	270	263
305FRA				ALL_W	14	24000	400	313	9	3000	74	114
305FRA				ALL	25	24000	500	424	15	3000	220	159
305FUF	1/25/05	80	-50									
305FUF	2/23/05	40	100									
305FUF	3/24/05	5000	9800									

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLI MAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305FUF	4/20/05	300	120									
305FUF	5/18/05	230	52									
305FUF	6/15/05	11000	9800									
305FUF	7/20/05	240	230									
305FUF	8/18/05	3000	400									
305FUF	9/15/05	30000	12000									
305FUF	10/13/05	90000	69000									
305FUF	11/10/05	900	510									
305FUF	12/7/05	80	160									
305FUF	1/11/06	220	85									
305FUF	2/22/06	80	35									
305FUF	3/15/06	2300	2400									
305FUF				05_06_D	6	90000	7000	4124	6	69000	5100	1840
305FUF				05_06_W	9	5000	220	289	8	9800	140	302
305FUF				05_06	15	90000	300	837	14	69000	315	655
305FUF				ALL_D	6	90000	7000	4124	6	69000	5100	1840
305FUF				ALL_W	9	5000	220	289	8	9800	140	302
305FUF				ALL	15	90000	300	837	14	69000	315	655
305HAR	1/24/05	110	10									
305HAR	2/22/05	130	180									
305HAR	3/23/05	11000	6900									
305HAR	4/21/05	30	52									
305HAR	5/19/05	2300	680									
305HAR	6/16/05	3000	550									
305HAR	7/21/05	300	1200									
305HAR	8/18/05	2400	3100									
305HAR	10/13/05	8000	8300									
305HAR	11/9/05	5000	6400									
305HAR	12/8/05	5000	5400									
305HAR	1/12/06	500	310									
305HAR	2/23/06	1300	130									
305HAR	3/16/06	1300	1800									
305HAR				05_06_D	5	8000	2400	2089	5	8300	1200	1631
305HAR				05_06_W	9	11000	1300	774	9	6900	310	490
305HAR				05_06	14	11000	1800	1103	14	8300	940	753
305HAR				ALL_D	5	8000	2400	2089	5	8300	1200	1631
305HAR				ALL_W	9	11000	1300	774	9	6900	310	490
305HAR				ALL	14	11000	1800	1103	14	8300	940	753
305HOL	2/10/98	300										
305HOL	3/5/98	900										
305HOL	6/12/98	110										
305HOL	7/20/98	16000										
305HOL	10/15/98	300										
305HOL	11/4/98	170										
305HOL	12/2/98	500										
305HOL	1/7/99	50										
305HOL	2/23/05	220	220									
305HOL	3/24/05	2400	1800									
305HOL	4/20/05	50	160									
305HOL	5/18/05	70	60									
305HOL	1/11/06	800	140									
305HOL	2/22/06	13	12									
305HOL	3/15/06	800	930									
305HOL				97_98_D	3	16000	300	808				
305HOL				97_98_W	5	900	300	258				
305HOL				97_98	8	16000	300	396				
305HOL				05_06_D	1	70	70	70	1	60	60	60
305HOL				05_06_W	6	2400	510	246	6	1800	190	215
305HOL				05_06	7	2400	220	205	7	1800	160	179
305HOL				ALL_D	4	16000	205	438	1	60	60	60
305HOL				ALL_W	11	2400	300	251	6	1800	190	215
305HOL				ALL	15	16000	300	291	7	1800	160	179
305LLA	12/18/97	130										
305LLA	1/19/98	3000										
305LLA	2/10/98	240										

ATTACHMENT 1 CCAMP DATA

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLI MAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305LLA	2/19/98	500										
305LLA	3/5/98	50										
305LLA	3/12/98	80										
305LLA	5/27/98	900										
305LLA	6/12/98	1600										
305LLA	6/30/98	170										
305LLA	7/20/98	5000										
305LLA	7/31/98	900										
305LLA	8/11/98	400										
305LLA	9/3/98	900										
305LLA	9/10/98	300										
305LLA	9/30/98	1600										
305LLA	10/15/98	900										
305LLA	10/21/98	900										
305LLA	11/4/98	130										
305LLA	11/10/98	110										
305LLA	12/2/98	500										
305LLA	12/16/98	130										
305LLA	1/7/99	170										
305LLA	1/25/05	80	110									
305LLA	2/23/05	300	280									
305LLA	3/24/05	2400	630									
305LLA	4/20/05	130	30									
305LLA	5/18/05	300	67									
305LLA	6/15/05	3000	170									
305LLA	7/20/05	300	280									
305LLA	8/18/05	500	270									
305LLA	9/15/05	230	290									
305LLA	10/13/05	2200	410									
305LLA	11/10/05	300	22									
305LLA	12/7/05	170	220									
305LLA	1/11/06	140	140									
305LLA	2/22/06	130	93									
305LLA	3/15/06	1100	930									
305LLA												
305LLA				97_98_D	11	5000	900	844				
305LLA				97_98_W	11	3000	130	207				
305LLA				97_98	22	5000	450	418				
305LLA				05_06_D	6	3000	400	639	6	410	275	216
305LLA				05_06_W	9	2400	170	270	9	930	140	148
305LLA				05_06	15	3000	300	381	15	930	220	172
305LLA				ALL_D	17	5000	900	765	6	410	275	216
305LLA				ALL_W	20	3000	155	233	9	930	140	148
305LLA				ALL	37	5000	300	403	15	930	220	172
305LUC	2/10/98	300										
305LUC	3/5/98	170										
305LUC	6/12/98	130										
305LUC	7/20/98	1600										
305LUC	8/11/98	500										
305LUC	9/10/98	3000										
305LUC	10/15/98	300										
305LUC	11/4/98	300										
305LUC	12/2/98	2400										
305LUC	1/7/99	1400										
305LUC				97_98_D	5	3000	500	623				
305LUC				97_98_W	5	2400	300	552				
305LUC				97_98	10	3000	400	586				
305LUC				ALL_D	5	3000	500	623				
305LUC				ALL_W	5	2400	300	552				
305LUC				ALL	10	3000	400	586				
305MON	2/10/98	300										
305MON	3/5/98	300										
305MON	6/12/98	80										
305MON	7/20/98	240										
305MON	8/11/98	110										

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLI MAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305MON	9/10/98	300										
305MON	10/15/98	80										
305MON	11/4/98	40										
305MON	12/2/98	300										
305MON	1/7/99	17										
305MON				97_98_D	5	300	110	138				
305MON				97_98_W	5	300	300	113				
305MON				97_98	10	300	175	125				
305MON				ALL_D	5	300	110	138				
305MON				ALL_W	5	300	300	113				
305MON				ALL	10	300	175	125				
305MUR	2/10/98	16000										
305MUR	3/5/98	50										
305MUR	6/12/98	300										
305MUR	7/20/98	300										
305MUR	8/11/98	170										
305MUR	9/10/98	80										
305MUR	10/15/98	300										
305MUR	11/4/98	300										
305MUR	12/2/98	900										
305MUR	1/7/99	30										
305MUR	1/24/05	50	10									
305MUR	2/22/05	500	500									
305MUR	3/23/05	50000	4600									
305MUR	4/19/05	170	52									
305MUR	5/17/05	30	52									
305MUR	6/14/05	80	69									
305MUR	7/19/05	130	10									
305MUR	8/17/05	130	41									
305MUR	9/13/05	240	74									
305MUR	10/12/05	230	63									
305MUR	11/9/05	80	63									
305MUR	12/6/05	50	63									
305MUR	1/10/06	80	160									
305MUR	2/21/06	80	28									
305MUR	3/14/06	500	270									
305MUR				97_98_D	5	300	300	206				
305MUR				97_98_W	5	16000	300	365				
305MUR				97_98	10	16000	300	274				
305MUR				05_06_D	6	240	130	114	6	74	58	44
305MUR				05_06_W	9	50000	80	241	9	4600	63	121
305MUR				05_06	15	50000	130	179	15	4600	63	81
305MUR				ALL_D	11	300	170	149	6	74	58	44
305MUR				ALL_W	14	50000	125	279	9	4600	63	121
305MUR				ALL	25	50000	170	212	15	4600	63	81
305OAK	2/10/98	240										
305OAK	3/5/98	300										
305OAK	6/12/98	30										
305OAK	7/20/98	500										
305OAK	8/11/98	70										
305OAK	9/10/98	220										
305OAK	10/15/98	188										
305OAK	11/4/98	27										
305OAK	12/2/98	220										
305OAK	1/7/99	2										
305OAK				97_98_D	5	500	188	134				
305OAK				97_98_W	5	300	220	61				
305OAK				97_98	10	500	204	91				
305OAK				ALL_D	5	500	188	134				
305OAK				ALL_W	5	300	220	61				
305OAK				ALL	10	500	204	91				
305PAC	12/18/97	300										
305PAC	1/19/98	400										
305PAC	2/19/98	900										
305PAC	3/12/98	80										

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLI MAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305PAC	5/27/98	30										
305PAC	6/30/98	50										
305PAC	7/31/98	330										
305PAC	9/3/98	1400										
305PAC	9/30/98	170										
305PAC	10/21/98	300										
305PAC	11/10/98	500										
305PAC	12/16/98	70										
305PAC	1/25/05	170	74									
305PAC	2/23/05	80	190									
305PAC	3/24/05	800	1200									
305PAC	4/20/05	500	84									
305PAC	5/18/05	240	210									
305PAC	6/15/05	900	88									
305PAC	7/20/05	240	240									
305PAC	8/18/05	500	280									
305PAC	9/15/05	500	210									
305PAC	10/13/05	800	110									
305PAC	11/10/05	240	26									
305PAC	12/7/05	500	260									
305PAC	1/11/06	110	110									
305PAC	2/22/06	130	98									
305PAC	3/15/06	500	230									
305PAC				97_98_D	6	1400	235	181				
305PAC				97_98_W	6	900	350	259				
305PAC				97_98	12	1400	300	217				
305PAC				05_06_D	6	900	500	467	6	280	210	175
305PAC				05_06_W	9	800	240	256	9	1200	110	142
305PAC				05_06	15	900	500	325	15	1200	190	154
305PAC				ALL_D	12	1400	315	291	6	280	210	175
305PAC				ALL_W	15	900	300	257	9	1200	110	142
305PAC				ALL	27	1400	300	272	15	1200	190	154
305PAJ	12/18/97	2400										
305PAJ	1/19/98	16000										
305PAJ	2/10/98	16000										
305PAJ	2/19/98	1600										
305PAJ	3/5/98	130										
305PAJ	3/12/98	130										
305PAJ	5/27/98	130										
305PAJ	6/12/98	50										
305PAJ	6/30/98	30										
305PAJ	7/20/98	300										
305PAJ	7/31/98	110										
305PAJ	8/11/98	170										
305PAJ	9/3/98	170										
305PAJ	9/10/98	500										
305PAJ	9/30/98	130										
305PAJ	10/15/98	80										
305PAJ	10/21/98	300										
305PAJ	11/4/98	240										
305PAJ	11/10/98	110										
305PAJ	12/2/98	5000										
305PAJ	12/16/98	130										
305PAJ	1/7/99	80										
305PAJ	1/25/05	30	52									
305PAJ	2/23/05	230	160									
305PAJ	3/24/05	2400	2900									
305PAJ	4/20/05	80	110									
305PAJ	5/18/05	230	31									
305PAJ	6/15/05	300	84									
305PAJ	7/20/05	80	41									
305PAJ	8/18/05	130	410									
305PAJ	9/15/05	80	300									
305PAJ	10/13/05	500	86									
305PAJ	11/10/05	130	130									

ATTACHMENT 1 CCAMP DATA

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLI MAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305PAJ	12/7/05	2400	860									
305PAJ	1/11/06	170	150									
305PAJ	2/23/06	30	58									
305PAJ	3/15/06	1300	820									
305PAJ				97_98_D	11	500	130	136				
305PAJ				97_98_W	11	16000	240	709				
305PAJ				97_98	22	16000	150	310				
305PAJ				05_06_D	6	500	180	175	6	410	85	102
305PAJ				05_06_W	9	2400	170	241	9	2900	150	234
305PAJ				05_06	15	2400	170	212	15	2900	130	168
305PAJ				ALL_D	17	500	130	149	6	410	85	102
305PAJ				ALL_W	20	16000	200	436	9	2900	150	234
305PAJ				ALL	37	16000	170	266	15	2900	130	168
305PES	12/18/97	900										
305PES				97_98_D	N/A							
305PES				97_98_W	1	900	900	900				
305PES				97_98	1							
305PES				ALL_D	N/A							
305PES				ALL_W	1	900	900	900				
305PES				ALL	1							
305PJP	12/11/02	110										
305PJP	2/10/03	110										
305PJP	3/11/03	50										
305PJP	3/1/04	700										
305PJP	3/29/04	130										
305PJP	5/17/04	230										
305PJP	6/21/04	130										
305PJP	8/3/04	170										
305PJP	12/9/04	1300										
305PJP	1/24/05	240	52									
305PJP	2/22/05	500	490									
305PJP	3/23/05	9000	11000									
305PJP	4/19/05	40	20									
305PJP	5/17/05	50	31									
305PJP	6/14/05	130	20									
305PJP	7/19/05	240	63									
305PJP	8/17/05	170	63									
305PJP	9/13/05	220	150									
305PJP	10/12/05	240	74									
305PJP	11/9/05	80	52									
305PJP	12/6/05	50	120									
305PJP	1/10/06	80	41									
305PJP	2/21/06	50	25									
305PJP	3/14/06	1100	1300									
305PJP				02_04_D	3	230	170	172				
305PJP				02_04_W	6	1300	120	204				
305PJP				02_04	9	1300	130	193				
305PJP				05_06_D	6	240	195	155	6	150	63	55
305PJP				05_06_W	9	9000	80	209	9	11000	52	153
305PJP				05_06	15	9000	170	186	15	11000	63	102
305PJP				ALL_D	9	240	170	161	6	150	63	55
305PJP				ALL_W	15	9000	110	207	9	11000	52	153
305PJP				ALL	24	9000	150	188	15	11000	63	102
305SAF	3/24/05	24000	20000									
305SAF				05_06_D	N/A	N/A	N/A	N/A	N/A		N/A	N/A
305SAF				05_06_W	1	24000	24000	24000	1	20000	20000	20000
305SAF				05_06	1	24000	24000	24000	1	20000	20000	20000
305SAF				ALL_D	N/A	N/A	N/A	N/A	N/A		N/A	N/A
305SAF				ALL_W	1	24000	24000	24000	1	20000	20000	20000
305SAF				ALL	1	24000	24000	24000	1	20000	20000	20000
305SAN	12/18/97	240										
305SAN	1/19/98	11000										
305SAN	2/19/98	900										
305SAN	3/12/98	9000										
305SAN	5/27/98	600										

ATTACHMENT 1 CCAMP DATA

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLI MAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305SAN	6/30/98	170										
305SAN	7/31/98	130										
305SAN	9/3/98	300										
305SAN	9/30/98	300										
305SAN	10/21/98	170										
305SAN	11/10/98	500										
305SAN	12/16/98	80										
305SAN	1/24/05	1300	860									
305SAN	2/22/05	130	910									
305SAN	3/23/05	50000	61000									
305SAN	4/19/05	230	450									
305SAN	5/17/05	220	160									
305SAN	6/14/05	800	400									
305SAN	7/19/05	5000	1900									
305SAN	8/17/05	2300	2500									
305SAN	9/13/05	130	160									
305SAN	10/12/05	3000	51									
305SAN	11/9/05	50	31									
305SAN	12/6/05	900	200									
305SAN	2/21/06	900	210									
305SAN	3/14/06	700	410									
305SAN				97_98_D	6	600	235	242				
305SAN				97_98_W	6	11000	700	974				
305SAN				97_98	12	11000	300	486				
305SAN				05_06_D	6	5000	1550	961	6	2500	280	368
305SAN				05_06_W	8	50000	800	696	8	61000	430	572
305SAN				05_06	14	50000	850	799	14	61000	405	473
305SAN				ALL_D	12	5000	300	483	6	2500	280	368
305SAN				ALL_W	14	50000	800	804	8	61000	430	572
305SAN				ALL	26	50000	550	635	14	61000	405	473
305SBA	3/23/05	50000	61000									
305SBA				05_06_D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
305SBA				05_06_W	1	50000	50000	50000	1	61000	61000	61000
305SBA				05_06	1	50000	50000	50000	1	61000	61000	61000
305SBA				ALL_D	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
305SBA				ALL_W	1	50000	50000	50000	1	61000	61000	61000
305SBA				ALL	1	50000	50000	50000	1	61000	61000	61000
305SJN	1/25/05	240	100									
305SJN	2/22/05	400	180									
305SJN	3/23/05	160001	130000									
305SJN	4/19/05	50	84									
305SJN	5/17/05	500	300									
305SJN	6/14/05	5000	3900									
305SJN	7/19/05	500	780									
305SJN	8/17/05	1100	440									
305SJN	9/13/05	500	170									
305SJN	10/12/05	2800	280									
305SJN	11/9/05	800	520									
305SJN	12/6/05	500	250									
305SJN	1/10/06	340	41									
305SJN	2/21/06	210	17									
305SJN	3/14/06	5000	1300									
305SJN				05_06_D	6	5000	800	1115	6	3900	370	517
305SJN				05_06_W	9	160001	400	782	9	130000	180	305
305SJN				05_06	15	160001	500	902	15	130000	280	377
305SJN				ALL_D	6	5000	800	1115	6	3900	370	517
305SJN				ALL_W	9	160001	400	782	9	130000	180	305
305SJN				ALL	15	160001	500	902	15	130000	280	377
305STL	1/24/05	240	-5									
305STL	2/22/05	240	31									
305STL	3/23/05	330	63									

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLI MAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305STL	4/21/05	2	10									
305STL	6/16/05	170	63									
305STL	7/21/05	23	190									
305STL	8/17/05	170	140									
305STL	10/12/05	700	240									
305STL	11/9/05	130	130									
305STL	12/8/05	40	52									
305STL	1/12/06	80	10									
305STL	2/23/06	50	41									
305STL	3/16/06	50	10									
305STL				05_06_D	4	700	170	147	4	240	165	142
305STL				05_06_W	9	330	80	70	8	130	36	29
305STL				05_06	13	700	130	88	12	240	58	50
305STL				ALL_D	4	700	170	147	4	240	165	142
305STL				ALL_W	9	330	80	70	8	130	36	29
305STL				ALL	13	700	130	88	12	240	58	50
305TES	12/18/97	240										
305TES	1/19/98	24000										
305TES	2/19/98	7000										
305TES	3/12/98	24000										
305TES	5/27/98	2400										
305TES	6/30/98	1600										
305TES	7/31/98	700										
305TES	9/3/98	5000										
305TES	9/30/98	5000										
305TES	10/21/98	9000										
305TES	11/10/98	9000										
305TES	12/16/98	5000										
305TES				97_98_D	6	9000	3700	2908				
305TES				97_98_W	6	24000	8000	5931				
305TES				97_98	12	24000	5000	4153				
305TES				ALL_D	6	9000	3700	2908				
305TES				ALL_W	6	24000	8000	5931				
305TES				ALL	12	24000	5000	4153				
305THU	12/18/97	9000										
305THU	1/19/98	5000										
305THU	2/10/98	4000										
305THU	2/19/98	3000										
305THU	3/5/98	240										
305THU	3/12/98	240										
305THU	5/27/98	130										
305THU	6/12/98	280										
305THU	6/30/98	220										
305THU	7/20/98	500										
305THU	7/31/98	300										
305THU	8/11/98	240										
305THU	9/3/98	500										
305THU	9/10/98	130										
305THU	9/30/98	14										
305THU	10/15/98	900										
305THU	10/21/98	80										
305THU	11/4/98	50										
305THU	11/10/98	80										
305THU	12/2/98	2400										
305THU	12/16/98	30										
305THU	1/7/99	34										
305THU	4/26/01	1400										
305THU	5/31/01	24000										
305THU	6/28/01	920										
305THU	7/25/01	3500										
305THU	8/30/01	230										
305THU	9/18/01	79										
305THU	10/16/01	240										
305THU	11/13/01	54000										
305THU	12/20/01	1600										

ATTACHMENT 1 CCAMP DATA

SiteTag	Date	FCOLI	ECOLI	PERIOD	FCOLI COUNT	FCOLIMAX	FCOLI MEDIAN	FCOLI GEOMEAN	ECOLI COUNT	ECOLI MAX	ECOLI MEDIAN	ECOLI GEOMEAN
305THU	1/21/02	1300										
305THU	3/18/02	130										
305THU	4/15/02	130										
305THU	5/13/02	1300										
305THU	7/17/02	110										
305THU	8/14/02	13										
305THU	9/11/02	4										
305THU	10/9/02	-1										
305THU	11/12/02	230										
305THU	6/21/04	240										
305THU	8/3/04	230										
305THU	10/5/04	240										
305THU	11/2/04	130										
305THU	1/24/05	130	31									
305THU	2/22/05	300	460									
305THU	3/23/05	7000	7500									
305THU	4/19/05	50	150									
305THU	5/17/05	240	120									
305THU	6/14/05	30	51									
305THU	7/19/05	30	20									
305THU	8/17/05	2	11									
305THU	9/13/05	4	1									
305THU	10/12/05	2	10									
305THU	11/9/05	30	20									
305THU	12/6/05	260	54									
305THU	1/10/06	240	120									
305THU	2/21/06	110	30									
305THU	3/14/06	300	1500									
305THU	4/5/06	2300	2400									
305THU				97_98_D	11	900	240	199				
305THU				97_98_W	11	9000	240	479				
305THU				97_98	22	9000	240	308				
305THU				01_04_D	13	24000	240	266				
305THU				01_04_W	8	54000	765	729				
305THU				01_04	21	54000	240	390				
305THU				05_06_D	6	240	17	12	6	120	16	15
305THU				05_06_W	10	7000	250	268	10	7500	135	216
305THU				05_06	16	7000	120	84	16	7500	53	80
305THU				ALL_D	30	24000	230	129	6	120	16	15
305THU				ALL_W	29	54000	240	440	10	7500	135	216
305THU				ALL	59	54000	240	236	16	7500	53	80
305TRE	12/19/97	23										
305TRE	2/19/98	300										
305TRE	3/12/98	280										
305TRE	5/27/98	30										
305TRE	6/30/98	300										
305TRE	7/31/98	1100										
305TRE	9/30/98	170										
305TRE	10/21/98	300										
305TRE	11/10/98	280										
305TRE	12/16/98	80										
305TRE	2/22/05	800	590									
305TRE	3/23/05	160000	160000									
305TRE	4/19/05	50	62									
305TRE	8/17/05	5000	910									
305TRE	9/13/05	1700	2100									
305TRE	1/10/06	300	500									
305TRE	3/14/06	500	280									
305TRE				97_98_D	5	1100	7	219				
305TRE				97_98_W	5	300	280	134				
305TRE				97_98	10	1100	280	171				
305TRE				05_06_D	2	5000	3350	2915	2	2100	1505	1382
305TRE				05_06_W	5	160000	500	992	5	160000	500	961
305TRE				05_06	7	160000	800	1350	7	160000	590	1066

305TRE				ALL_D	7	5000	300	459	2	2100	1505	1382
305TRE				ALL_W	10	160000	290	365	5	160000	500	961
305TRE				ALL	17	160000	300	401	7	160000	590	1066
305UVA	12/18/97	130										
305UVA	1/19/98	1100										
305UVA	2/19/98	1600										
305UVA	3/12/98	13										
305UVA	5/27/98	130										
305UVA	6/30/98	110										
305UVA	12/16/98	300										
305UVA	1/25/05	50	52									
305UVA	2/23/05	50	130									
305UVA	3/24/05	300	170									
305UVA	4/20/05	240	52									
305UVA	5/18/05	230	98									
305UVA	6/15/05	3000	41									
305UVA	12/7/05	30	31									
305UVA	1/11/06	110	86									
305UVA	2/22/06	50	49									
305UVA	3/15/06	300	120									
305UVA				97_98_D	2	130	120	120				
305UVA				97_98_W	5	1600	300	246				
305UVA				97_98	7	1600	130	200				
305UVA				05_06_D	2	3000	1615	831	2	98	70	63
305UVA				05_06_W	8	300	80	99	8	170	69	74
305UVA				05_06	10	3000	170	151	10	170	69	72
305UVA				ALL_D	4	3000	180	315	2	98	70	63
305UVA				ALL_W	13	1600	130	140	8	170	69	74
305UVA				ALL	17	3000	130	169	10	170	69	72
305VIS	2/10/98	900										
305VIS	3/5/98	500										
305VIS	6/12/98	70										
305VIS				97_98_D	1	70	70	70				
305VIS				97_98_W	2	900	700	671				
305VIS				97_98	3	900	500	316				
305VIS				ALL_D	1	70	70	70				
305VIS				ALL_W	2	900	700	671				
305VIS				ALL	3	900	500	316				
305WSA	1/24/05	70	-50									
305WSA	4/21/05	30	100									
305WSA	5/19/05	1300	200									
305WSA	6/16/05	240	97									
305WSA	7/21/05	240	10									
305WSA	8/18/05	30000	41000									
305WSA	10/13/05	2200	200									
305WSA	11/9/05	300	410									
305WSA	12/8/05	800	-50									
305WSA	1/12/06	240	260									
305WSA	2/23/06	30	41									
305WSA	3/16/06	170	240									
305WSA				05_06_D	5	30000	1300	1377	5	41000	200	276
305WSA				05_06_W	7	800	170	130	5	410	240	160
305WSA				05_06	12	30000	240	347	10	41000	200	210
305WSA				ALL_D	5	30000	1300	1377	5	41000	200	276
305WSA				ALL_W	7	800	170	130	5	410	240	160
305WSA				ALL	12	30000	240	347	10	41000	200	210

ATTACHMENT 2

WATER BOARD MONITORING DATA

SiteID	Date	Time	QA/QC	Total Coliform	*E. coli*	Total coliform median	E. coli median	Total coliform geomean	E. coli geomean
305ALD	11/30/06	10:40		Dry	Dry				
305ALD	12/12/06	11:35		Dry	Dry				
305ALD	12/28/06	11:07		Dry	Dry				
305ALD	1/11/07	10:45		Dry	Dry				
305ALD	1/25/07	10:32		Dry	Dry				
305ALL	11/30/06	10:35		Dry	Dry				
305ALL	12/12/06	11:42		Dry	Dry				
305ALL	12/28/06	11:02		Dry	Dry				
305ALL	1/11/07	10:43		Dry	Dry				
305ALL	1/25/07	10:30		Dry	Dry				
305BCC	11/30/06	11:50		547.7	145.5				
305BCC	12/12/06	13:58		1119.9	139.6				
305BCC	12/28/06	13:15		1986.3	547.5				
305BCC	1/11/07	12:40		365.4	74.9				
305BCC	1/25/07	12:21		727	488.4	727	145.5	798.0	209.8
305BRI	11/30/06	10:59		218.7	127.4				
305BRI	12/12/06	14:33		2419.6	198.9				
305BRI	12/28/06	14:00		142.1	68.3				
305BRI	1/11/07	13:21		131.4	33.6				
305BRI	1/25/07	12:56		204.6	155.3	204.6	127.4	289.2	98.0
305BRI2	12/28/06	14:00	FD	137.6	69.7				
305CHI	11/30/06	13:45		2419.6	17.1				
305CHI	12/12/06	9:30		2419.6	161.6				
305CHI	12/28/06	9:08		2419.6	142.1				
305CHI	1/11/07	9:11		2419.6	21.6				
305CHI	1/25/07	8:50		2419.6	21.3	2419.6	21.6	2419.6	44.8
305CHI2	1/11/07	9:11	FD	2419.6	27.5				
305FRA	11/30/06	11:20		1046.2	248.1				
305FRA	12/12/06	12:25		1732.9	116.2				
305FRA	12/28/06	11:48		1986.3	104.3				
305FRA	1/11/07	11:15		2419.6	93.2				
305FRA	1/25/07	11:06		1553.1	55.6	1732.9	104.3	1683.7	109.3
305FRA2	11/30/06	11:20	FD	980.4	275.5				
305FUF	11/30/06	11:30		2419.6	325.5				
305FUF	12/12/06	11:55		2419.6	155.3				
305FUF	12/28/06	11:19		2419.6	63.1				
305FUF	1/11/07	10:55		2419.6	122.3				
305FUF	1/25/07	10:42		1413.6	187.2	2419.6	155.3	2173.0	148.8
305FUF2	11/30/06	11:30	FS	2419.6	206.4				
305HRL	11/30/06	9:45		95.9	60.2				
305HRL	12/12/06	15:42		198.9	58.3				
305HRL	12/28/06	15:03		62.7	37.3				
305HRL	1/11/07	14:25		63.1	23.1				
305HRL	1/25/07	13:54		88.4	39.3	88.4	39.3	92.2	41.2
305HRL2	1/11/07	14:25	FD	56.3	17.3				
305LLA	11/30/06	11:40		Dry	Dry				
305LLA	12/12/06	12:05		2419.6	225.4				
305LLA	12/28/06	11:27		2419.6	204.6				
305LLA	1/11/07	11:00		2419.6	102.2				
305LLA	1/25/07	10:49		2419.6	123.6	2419.6	164.1	2419.6	155.4

SiteID	Date	Time	QA/QC	Total Coliform	*E. coli*	Total coliform median	E. coli median	Total coliform geomean	E. coli geomean
305LLA2	12/12/06	12:05	FD	2419.6	285.1				
305MON	11/30/06	10:30		1553.1	140.1				
305MON	12/12/06	11:08		2419.6	214.2				
305MON	12/28/06	10:41		1732.9	86.5				
305MON	1/11/07	10:28		1986.3	34.5				
305MON	1/25/07	10:10		2419.6	23.3	1986.3	86.5	1991.1	73.1
305MUR	11/30/06	14:10		1119.9	10.9				
305MUR	12/12/06	9:12		2419.6	167				
305MUR	12/28/06	8:49		2419.6	58.3				
305MUR	1/11/07	8:56		2419.6	14.8				
305MUR	1/25/07	8:35		2419.6	7.4	2419.6	14.8	2074.1	25.9
305MUR2	1/25/07	8:35	FD	2419.6	11				
305PAC	11/30/06	11:00		579.4	83.6				
305PAC	12/12/06	12:45		2419.6	410.6				
305PAC	12/28/06	12:11		1732.9	117.8				
305PAC	1/11/07	11:37		920.8	150				
305PAC	1/25/07	11:25		1413.6	416	1413.6	150	1258.9	190.7
305PAC2	1/11/07	11:37	FD	2419.6	248.9				
305PAJ	11/30/06	13:25		2419.6	39.3				
305PAJ	12/12/06	10:42		2419.6	154.1				
305PAJ	12/28/06	10:11		2419.6	285.1				
305PAJ	1/11/07	10:02		2419.6	98.8				
305PAJ	1/25/07	9:42		2419.6	42.6	2419.6	98.8	2419.6	93.8
305PAJ2	1/11/07	10:02	FD	2419.6	73.8				
305PJP	11/30/06	14:20		1203.3	35				
305PJP	12/12/06	8:40		2419.6	365.4				
305PJP	12/28/06	8:32		2419.6	201.4				
305PJP	1/11/07	8:38		2419.6	142.1				
305PJP	1/25/07	8:18		2419.6	27.5	2419.6	142.1	2104.1	100.1
305PJPSD	12/12/06	8:46		2419.6	2419.6				
305PJPSD	12/28/06	8:32		Dry	Dry				
305PJPSD	1/11/07	8:38		Dry	Dry				
305PJPSD	1/25/07	8:18		Dry	Dry				
305PJPSD2	12/12/06	8:46	FD	2419.6	2419.6				
305PSB	11/30/06	11:25		2419.6	161.6				
305PSB	12/12/06	14:13		2419.6	146.7				
305PSB	12/28/06	13:34		2419.6	107.6				
305PSB	1/11/07	12:57		2419.6	133.3				
305PSB	1/25/07	12:35		2419.6	90.6	2419.6	133.3	2419.6	125.2
305PSB2	11/30/06	11:25	FD	2419.6	185				
305SAF	11/30/06	12:48		2419.6	387.3				
305SAF	12/12/06	13:07		2419.6	1046.2				
305SAF	12/28/06	12:24		2419.6	128.1				
305SAF	1/11/07	11:54		1986.3	25.6				
305SAF	1/25/07	11:39		2419.6	111.2	2419.6	128.1	2326.0	171.4
305SAFSD	11/30/06	12:50		2419.6	920.8				
305SAFSD	12/12/06	13:01		2419.6	980.4				
305SAFSD	12/28/06	12:28		2419.6	151.5				
305SAFSD	1/11/07	11:59		2419.6	6.3				
305SAFSD	1/25/07	11:42		2419.6	59.8	2419.6	151.5	2419.6	138.8

SiteID	Date	Time	QA/QC	Total Coliform	*E. coli*	Total coliform median	E. coli median	Total coliform geomean	E. coli geomean
305SAN	11/30/06	14:10		2419.6	365.4				
305SAN	12/12/06	9:54		2419.6	1986.3				
305SAN	12/28/06	9:38		2419.6	1413.6				
305SAN	1/11/07	9:31		1986.3	165.8				
305SAN	1/25/07	9:08		866.4	40.8	2419.6	365.4	1894.1	370.1
305SAN2	12/28/06	9:38	FD	2419.6	1299.7				
305SBA	11/30/06	10:20		148.3	32.3				
305SBA	12/12/06	15:06		178.5	64.4				
305SBA	12/28/06	14:34		517.2	148.3				
305SBA	1/11/07	13:52		648.8	365.4				
305SBA	1/25/07	13:24		325.5	105	325.5	105	310.6	103.4
305SJB	11/30/06	13:39		2419.6	10.9				
305SJB	12/12/06	10:22		2419.6	2419.6				
305SJB	12/28/06	9:55		2419.6	365.4				
305SJB	1/11/07	9:44		2419.6	224.7				
305SJB	1/25/07	9:24		2419.6	93.3	2419.6	224.7	2419.6	182.4
305SJB2	1/25/07	9:25	FD	2419.6	93.2				
305SJN	11/30/06	13:57		2419.6	108.1				
305SJN	12/12/06	9:47		2419.6	111.2				
305SJN	12/28/06	9:28		2419.6	160.7				
305SJN	1/11/07	9:24		2419.6	83.6				
305SJN	1/25/07	9:02		2419.6	48	2419.6	108.1	2419.6	95.0
305TES	11/30/06	11:15		2419.6	579.4				
305TES	12/12/06	12:33		2419.6	116.9				
305TES	12/28/06	11:58		2419.6	461.1				
305TES	1/11/07	11:24		2419.6	488.4				
305TES	1/25/07	11:16		2419.6	290.9	2419.6	461.1	2419.6	338.4
305TES2	1/25/07	11:16	FD	2419.6	613.1				
305THU	11/30/06	14:40		488.4	9.6				
305THU	12/12/06	8:18		2419.6	238.2				
305THU	12/28/06	8:18		2419.6	248.1				
305THU	1/11/07	8:20		2419.6	18.5				
305THU	1/25/07	8:01		2419.6	20.1	2419.6	20.1	1756.9	46.2
305TRE	11/30/06	12:18		Dry	Dry				
305TRE	12/12/06	13:30		2419.6	165.8				
305TRE	12/28/06	12:50		2419.6	124.6				
305TRE	1/11/07	12:19		2419.6	36.4				
305TRE	1/25/07	12:00		2419.6	25.9	2419.6	80.5	2419.6	66.4
305TRE2	12/12/06	13:30	FS	2419.6	128.1				
305UVA	11/30/06	11:50		2419.6	115.3				
305UVA	12/12/06	12:13		2419.6	163.8				
305UVA	12/28/06	11:38		2419.6	201.4				
305UVA	1/11/07	11:07		2419.6	135.4				
305UVA	1/25/07	10:56		2419.6	185	2419.6	163.8	2419.6	157.0
305UVA2	12/28/06	11:38	FD	2419.6	143.9				
305WIL	11/30/06	10:50		Dry	Dry				
305WIL	12/12/06	14:40		Dry	Dry				
305WIL	12/28/06	14:08		Dry	Dry				
305WIL	1/11/07	13:27		Dry	Dry				
305WIL	1/25/07	13:02		Dry	Dry				
BATCH BLANK	11/30/06	17:14		1	1				

ATTACHMENT 3

LAND USE DATA

California Department of Conservation, Division of Land Resource Protection, Farmland Mapping and Monitoring Program (FMMP)

Prime Farmland (P)
Irrigated land with the best combination of physical and chemical features able to sustain long term production of agricultural crops. This land has the soil quality, growing season, and moisture supply needed to produce sustained high yields. Land must have been used for production of irrigated crops at some time during the four years prior to the mapping date

Farmland of Statewide Importance (S)
Irrigated land similar to Prime Farmland that has a good combination of physical and chemical characteristics for the production of agricultural crops. This land has minor shortcomings, such as greater slopes or less ability to store soil moisture than Prime Farmland. Land must have been used for production of irrigated crops at some time during the four years prior to the mapping date

Unique Farmland (U)
Lesser quality soils used for the production of the state's leading agricultural crops. This land is usually irrigated, but may include non-irrigated orchards or vineyards as found in some climatic zones in California. Land must have been cropped at some time during the four years prior to the mapping date.

Farmland of Local Importance (L)
Land cultivated as dry cropland. Usual crops are wheat, barley, oats, safflower, and grain hay. The Board of Supervisors determined that there will be no Farmland of Local Importance for Monterey County. In Santa Cruz County, soils used for Christmas tree farms and nurseries, and that do not meet the definition for Prime, Statewide, or Unique.

Grazing Land (G)
Land on which the existing vegetation is suited to the grazing of livestock. This category is used only in California and was developed in cooperation with the California Cattlemen's Association, University of California Cooperative Extension, and other groups interested in the extent of grazing activities. The minimum mapping unit for Grazing Land is 40 acres.

Urban and Built-Up Land (D)
Urban and Built-Up land is occupied by structures with a building density of at least 1 unit to 1.5 acres, or approximately 6 structures to a 10-acre parcel. Common examples include residential, industrial, commercial, institutional facilities, cemeteries, airports, golf courses, sanitary landfills, sewage treatment, and water control structures.

Other Land (X)
Land which does not meet the criteria of any other category. Typical uses include low density rural development, heavily forested land, mined land, or government land with restrictions on use.

Water (W)
Water areas with an extent of at least 40 acres.